SHIP JOINERY

S. G. DUCKWORTH

ROUTLEDGE'S MODERN TRADE-BOOK SERIES

EDITED BY R. GREENHALGH

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Ship Joinery

THE WOODWORK FITTINGS OF A MODERN STEEL VESSEL

By

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With 700 Illustrations

GEORGE ROUTLEDGE & SONS, LTD.

BROADWAY HOUSE: 68-74 CARTER LANE, LONDON, E.C.

1923

PRINTED IN GREAT BRITAIN BY
THE EDINBURGH PRESS, 9 AND 11 YOUNG STREET, EDINBURGH

PREFACE

WHILE there are several books dealing with the subjects of carpentry and joinery and cabinetmaking, the Author believes this to be the first attempt, to deal at any length, with that important branch of joinery-work required in a modern ship. It will be readily admitted that not only are the workshop methods different, but the design of the different parts of a ship and their construction call for entirely special knowledge and treatment; also the curved outline of the hull, the curvature of the decks, and the fitting and fastening of joinery-work to steel, present many difficulties not met with in work ashore.

There is a definite line of demarcation between the work of the ship carpenter, or shipwright, and that of the ship joiner. The former sets the keel blocks, props, staging, and ribbands in position, and deals with the woodwork connected with the structural part of the ship; while the latter deals with fittings and furnishings of the interior, and it is to this work that the following pages are devoted.

During the past few years, great changes have taken place in the equipping and furnishing of passenger liners; and with the still growing demand of the public for a higher standard of comfort, the designer and craftsman will be called upon to execute and supply work of a higher quality to meet this demand. Hence, it will be necessary to give apprentices the very best training possible, and to offer the journeymen facilities for their improvement.

The methods of workshop practice vary greatly in the

different shipyards, but the Author hopes that the general outline given in the following pages will provide the ambitious journeyman or apprentice with a ready means whereby a knowledge of present-day practice may be acquired.

The Author would like to place on record his indebtedness to John Dick's Press Ltd., for allowing the reproduction of 120 illustrations which he originally contributed to their journal, "The Illustrated Carpenter and Builder"; to Messrs John M'Dowall & Sons, Johnstone, for illustrations of their machines, Figs. 112-140; and to Messrs Thos. White & Sons Ltd., Paisley, for an illustration of their dovetailing machine, Fig. 125; also to the Editor for many useful suggestions and advice during the preparation of the work.

BELFAST. S. G. D.

CONTENTS

SHIP JOINERY

CHAPTER I

HAND TOOLS

WHILE machine tools of various kinds are introduced for special operations and for increasing production, hand tools and their skilful manipulation must always be the pride of the good craftsman. There is a joy in producing any article in its entirety, which is certainly lacking when the different processes are spread over numbers of workmen and machinists, and where the craftsman's work is often simply resolved into gluing up and finishing. We must, however, adjust ourselves to the conditions prevailing in a modern workshop; but, at the same time, a craftsman should not be content until he feels that he has sufficient skill in the use of his tools to undertake any class of work.

A knowledge of the tools he uses is naturally a preliminary to a skilful use of such tools; therefore, such information is here given as is necessary regarding the construction, mechanical properties, and maintenance of hand tools.

SAWS

Saws of various kinds form an important part of the "kit," and may be classified as: (*a*) those required to cut flat surfaces, and (*b*) those required to cut curved surfaces.

In the former class are included the rip saw, hand or cross-cut saw, panel saw, tenon saw, and dovetail saw; while the latter class comprises the pad saw, compass saw, and the bow saw.

Saws generally are designed to sever the wood with as little waste as possible, and consequently with the least effort. This should be remembered when *setting* saws, so as to give just the necessary amount of clearance; too much *set* entails extra effort in cutting. The handle should be smooth and comfortable; beech is commonly used for this purpose, but applewood makes a splendid handle.

Testing the Quality of a Saw.—The blade should be thin; when bent it should show a uniform curve, and when released it should return to its original form. The *tempering* should be hard. Hard steel, although entailing more work in sharpening, has the advantage of retaining the sharp points much longer. Well-tempered saws have a bluish colour, and when tapped should give a clear bell-like ring.

The Rip Saw, as its name implies, is used for *ripping* or cutting with the grain; a sketch of a rip saw is shown in Fig. 1. The teeth are large (see Figs. 2, 3, and 4), being about three per inch, though in half-rip saws there are as many as five teeth per inch. The *leading face* of the tooth (the edge of the tooth which first enters the wood) is inclined at an angle of 80°, and the *tooth angle* is 60°. The teeth are filed square from the face of the blade and each tooth has the action of a small chisel; very little set is required for rip saws, especially when used in cutting dry timber.

Hand Saws have six to eight teeth per inch, and are constructed for cutting across the grain. They are made with straight backs, or with hollow backs similar to the rip saw shown. The chief difference is in the shape of the teeth. The leading face is inclined at an angle of 70°, and the tooth angle is 60°. They are sharpened with the file inclined at an angle to the face of the blade, which results in teeth as shown in Figs. 5, 6, and 7. This makes the very fine cutting points, which act like small chisels, and sever the fibres across the grain.

Panel Saws are similar to cross-cut saws except that the blade is shorter and the teeth number about ten per inch.

The Tenon Saw, Fig. 8, is used for finer and smaller cuts. Its blade is thin and is stiffened by a brass or steel back sprung on to its upper edge. The teeth are in the shape of equilateral triangles, and the leading face of the tooth is pitched at 60°.

The Dovetail Saw, as shown in Fig. 9, is used chiefly, as its name implies, for dovetailing, or for any fine cutting. It is very similar to the tenon saw, but has about fourteen teeth per inch.

The Bow Saw, Fig. 10, is used for cutting curved outlines. The blade is consequently made narrow, and the teeth vary in size, with about six points per inch. It is kept in tension by means of two arms, or levers, working on a fulcrum, or stretcher; the arms are drawn inwards by a cord twisted by a twitch, which results in forcing out the handles to which the blade is attached.

The Pad Saw, Fig. 11, is useful for small work and is sometimes called a *keyhole saw*. The blade can be stowed away in the handle, or pad, which is slotted to receive same. It can be held in any desired position in the pad by two set-screws.

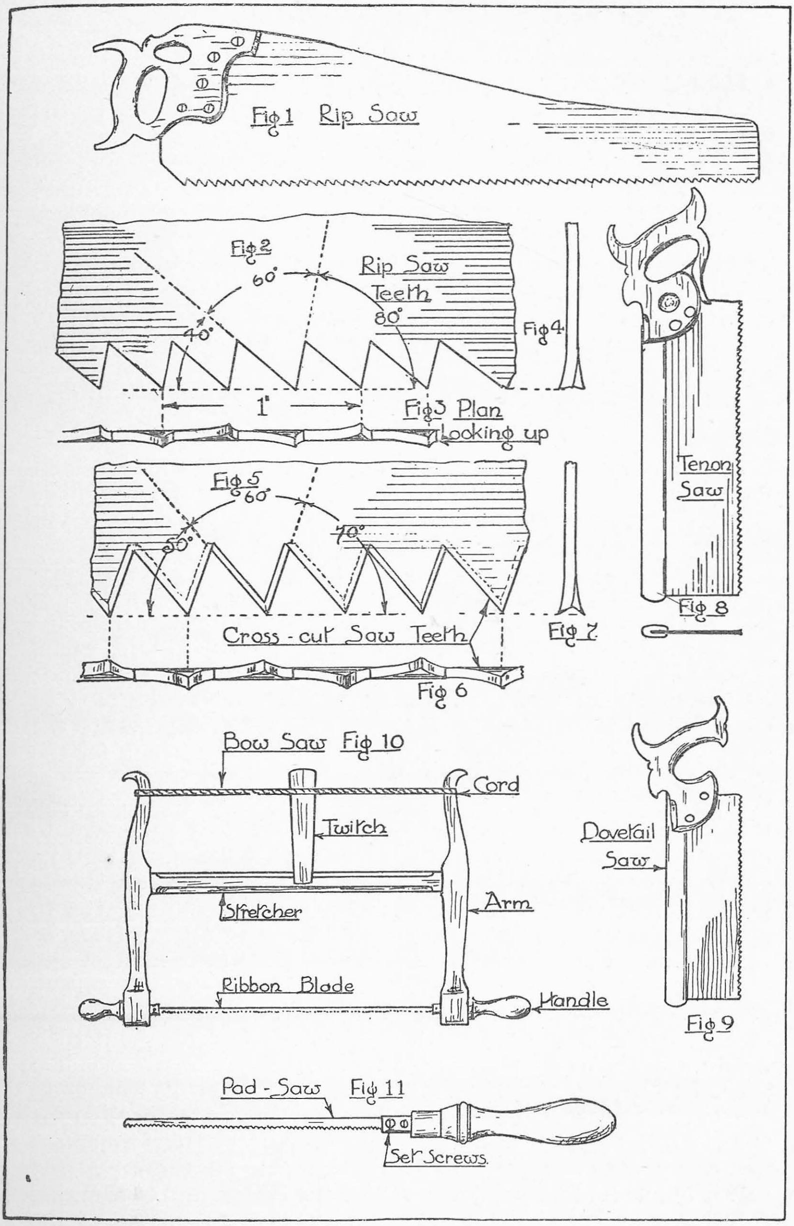


Fig 1 Rip Saw
Fig 2
Rip Saw Teeth
60°
80°
40°
Fig 4
1"
Fig 3 Plan Looking up
Fig 5
60°
50°
70°
Cross-cut Saw Teeth
Fig 7
Fig 6
Tenon Saw
Fig 8
Bow Saw Fig 10
Cord
Twitch
Stretcher
Arm
Ribbon Blade
Handle
Dovetail Saw
Fig 9
Pad-Saw Fig 11
Set Screws.

PLANES

Planing is probably the most important and most frequent of the tool operations. The preparing of true surfaces is the foundation for all subsequent work ; also, the finishing of surfaces, with plane and scraper, for polishing and painting, are still operations that machine tools cannot undertake successfully, and must be done by hand. Many of the surface planing machines produce a fairly true surface, but the wave-like indentations which result require to be levelled by the smoothing plane.

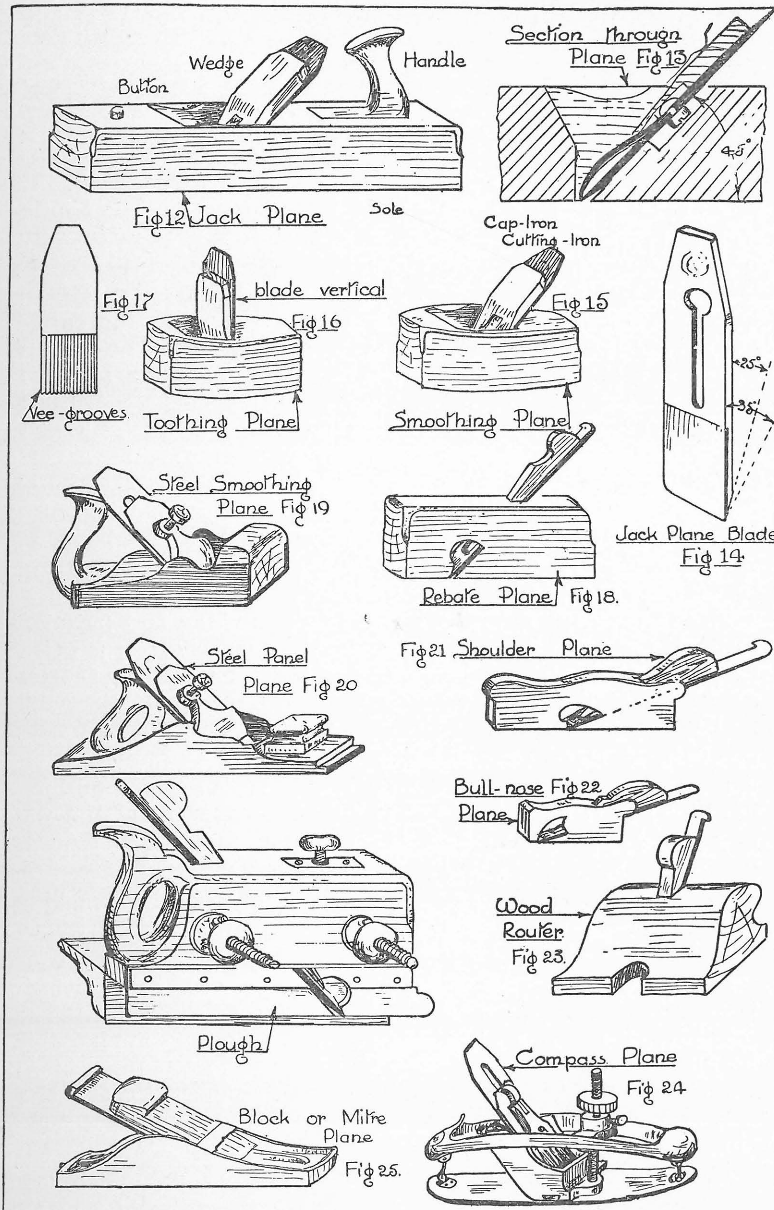
Planes may roughly be divided into three classes : (*a*) those required to produce level surfaces ; (*b*) planes required to produce concave and convex surfaces ; (*c*) those required to produce moulded surfaces.

The plane-sole is in most cases just the opposite shape to that required on the surface of the wood.

The Jack Plane is used for removing the rough surface and for making the wood fairly true ; and, seeing that most other types of planes are constructed on the same principle, a full description of the parts is here given.

Fig. 12 shows a sketch of the plane and Fig. 13 gives a longitudinal section through the escapement. The *body*, or *stock*, of the plane is made of beech, which should be straight in grain.

The names of the various parts are : (*a*) the *handle*, which is sunk in the stock ; (*b*) the *sole* or under surface of the plane ; (*c*) the *button*, usually of boxwood, which receives the blow of the hammer when the iron is being released and prevents the body being damaged ; (*d*) the *escapement* is the opening for the shavings to escape ; (*e*) the *mouth* is the opening in the sole of the plane. When the plane-sole has been " trued " up several times, this opening becomes too wide and it is necessary to house a piece of boxwood into the sole, to make the mouth its correct size ; (*f*) the *wedge* for holding in the cutter : it should fit tight down on the cutter, otherwise it will allow the cutter to " chatter " and thus leave the surface uneven ; (*g*) the *blade*, or *cutting iron*, is shown in Fig. 14. It is made of mild steel and faced by tool steel to a distance of about 2 in. from the cutting edge. It is ground to an angle of 25° and sharpened at an angle of 35°. Some blades are of an even thickness throughout their length, and others are tapered. The latter, after grinding several times, become shorter, and are consequently thinner at the cutting edge ; therefore, they allow a greater opening at the mouth, which is a decided disadvantage. The former are invariably used for steel or metal planes ; (*h*) the *cover iron* serves the double purpose of stiffening the cutter, and of breaking the shaving ; or, in other words, it changes the action of the


Button
Wedge
Handle
Fig 12 Jack Plane
Sole
Section through Plane Fig 13
45°
Fig 17
Vee-grooves
blade vertical
Fig 16
Toothing Plane
Cap-Iron
Cutting-Iron
Fig 15
Smoothing Plane
25°
35°
Jack Plane Blade Fig 14
Steel Smoothing Plane Fig 19
Rebate Plane Fig 18.
Steel Panel Plane Fig 20
Fig 21 Shoulder Plane
Bull-nose Fig 22 Plane
Wood Router Fig 23.
Plough
Compass Plane Fig 24
Block or Mitre Plane Fig 25.

cutter from a splitting action into a cutting and scraping action. The cover is set very closely to the cutting edge when used on hardwoods.

The Trying Plane is similar in construction to the jack plane, but is larger, being about 22 in. in length ; the jack plane is about 17 in. long. The cutter is from $2\frac{1}{4}$ in. to $2\frac{1}{2}$ in. wide, and is sharpened almost square—with the corners rounded off. It is used for jointing and "trueing" large surfaces. The **jointer** is a trying plane of still greater length, and is used exclusively for trueing long surfaces to be jointed.

The Smoothing Plane, Fig. 15, as its name implies, is used for smoothing or finishing work. The angle which the cutter makes with the sole of the plane is from 45° to 50°. The body is shaped to make it easier to hold and to reduce the friction between the sole and surface of the wood. The cutting edge is sharpened almost square, and the cover iron should be set very close to get good results.

The Toothing Plane has grooves cut into the steel face of the cutter, Fig. 17, so that when sharpened the cutting edge has a series of small teeth. It is set vertically in the body, as shown in Fig. 16, and is used for toothing surfaces preparatory to veneering, and also for preparing surfaces to be scraped.

The Rebate Plane, Fig. 18, is used for making and finishing rebates. The sole is parallel and about $1\frac{1}{4}$ in. wide ; it is fitted with a single iron. There are two varieties : one with the cutter square across the sole, and the other with the iron "skewed," that is, set at an angle. The **side fillister** is a form of rebate plane with a movable fence attached to the sole.

Steel Smoothing Plane.—This plane, Fig. 19, is used for finishing hardwoods. It can be set to take a very fine shaving and the *lever and screw* method of fixing the irons in position reduces chattering to a minimum.

The Steel Panel Plane, or Jointer, Fig. 20, is used for making joints, and for all classes of work in hardwoods. Its length varies from 13 in. to 18 in.

The Steel Shoulder Plane, Fig. 21, has a single iron, which is bevelled, and this ground side is placed uppermost. The iron is set at an angle of 20° in the plane. Castings in malleable iron can be obtained from iron-founders, and joiners often fill in the wooden parts themselves. As its name implies, the shoulder plane is used for finishing shoulders to tenons, or any other similar work.

The Plough Plane is used for cutting grooves along the grain.

The Bull-nose Plane, Fig. 22, is like a short shoulder plane,

only the mouth is very near to the nose of the plane. It is used for planing up to *stopped parts* in rebates.

The Wood Router, Fig. 23, is used for levelling recesses; it is often called a " granny's tooth."

Compass Plane.—A *Stanley* compass plane is shown in Fig. 24. It is used for planing concave or convex surfaces. The sole is of thin steel, and, by means of a screw, can be raised or lowered in the centre to form a hollow or round sole. The cutter, cover, and lever are fixed in a shoe, which moves along with the plane-sole to any desired position.

The Block, or Mitre, Plane, Fig. 25, has a single iron set at an angle of 20°. It is used for planing end-grain and oblique cuts, such as mitres.

Moulding Planes include the *ogee, bead, lamb's tongue,* etc., but are little used in a modern workshop, as all the moulding is done by machinery.

BRACE AND BITS

Brace.—Arising out of the need for some means to turn the various bits, and at the same time give the necessary leverage, the modern brace has come into being. The brace is one of the most useful of tools and is almost indispensable to the joiner. It is composed of a bent *crank* of $\frac{1}{2}$ in. round steel, which is fitted with a *head* mounted on ball bearings and a turned *handle.* The bits are held in position by a pair of *jaws,* which are tightened over the bit by a *cone,* or *cover,* that screws on to the crank. The inside of this cover is conical shaped, and as it is screwed on it presses the tapered part of the jaws together. The bits are made with a square tapered end to fit into the jaws. A *ratchet* arrangement is fitted to the brace shown in Fig. 26, and enables the crank to be turned in either direction without any movement of the bit. This allows the brace to be used in corners where it would be impossible to get a full turn of the crank.

Bits.—The CENTRE BIT, Fig. 27, is used for boring across the grain; the centre point *c* allows the bit to be started at an exact point, but if used in thick material this bit cannot be relied on to follow a straight direction. The *cutter a* severs the fibres and the *router b* lifts out the core.

The TWIST BIT, usually of the *Jenning's* pattern, as shown in Fig. 28, is largely used. It will follow a fairly straight line once it is entered in the wood, because the cutters are balanced. The *twisted shank* draws the bit into the wood, thus requiring less energy to turn. GEDGES twist bit, Fig. 36, is used for boring in *end-grain;* it has a pair of cutters which act like small gouges.

It cuts very clean and with very little effort. Both the latter bits can be used with an *auger handle* as shown in sketch, Fig. 28; this is necessary when the bits are very long.

The SPOON BIT and NOSE BIT, Figs. 29 and 30, are both used for the purpose of boring small holes for screws, etc., on account of their smooth gouge-like action in cutting; they can be forced right through a piece of wood without spalling the fibres to any great extent.

The SCREWDRIVER BIT, Fig. 31, is used for turning screws, and when used with the brace makes a very quick and efficient screwdriver.

The ROSE COUNTERSINK, Fig. 32, is used for boring conical holes to receive the heads of screws; it can also be used on metal. The WOOD COUNTERSINK, Fig. 33, is for the same purpose, only it is to be used exclusively on wood.

The FORSTNER BIT, Fig. 34, is used for boring holes a short distance into the wood; it leaves a clean surface at the bottom without the usual mark made by the centre point of the bit. It is guided by its periphery, which is sharpened to sever the fibres vertically, and the core is lifted out by inclined cutters. It is useful for any kind of ornamental sinkings.

The EXPANDING BIT, Fig. 35, is a form of centre bit with a cutter and router which can be moved in relation to the centre point. It is made in various sizes, one size boring holes varying from $\frac{7}{8}$ in. to 3 in.

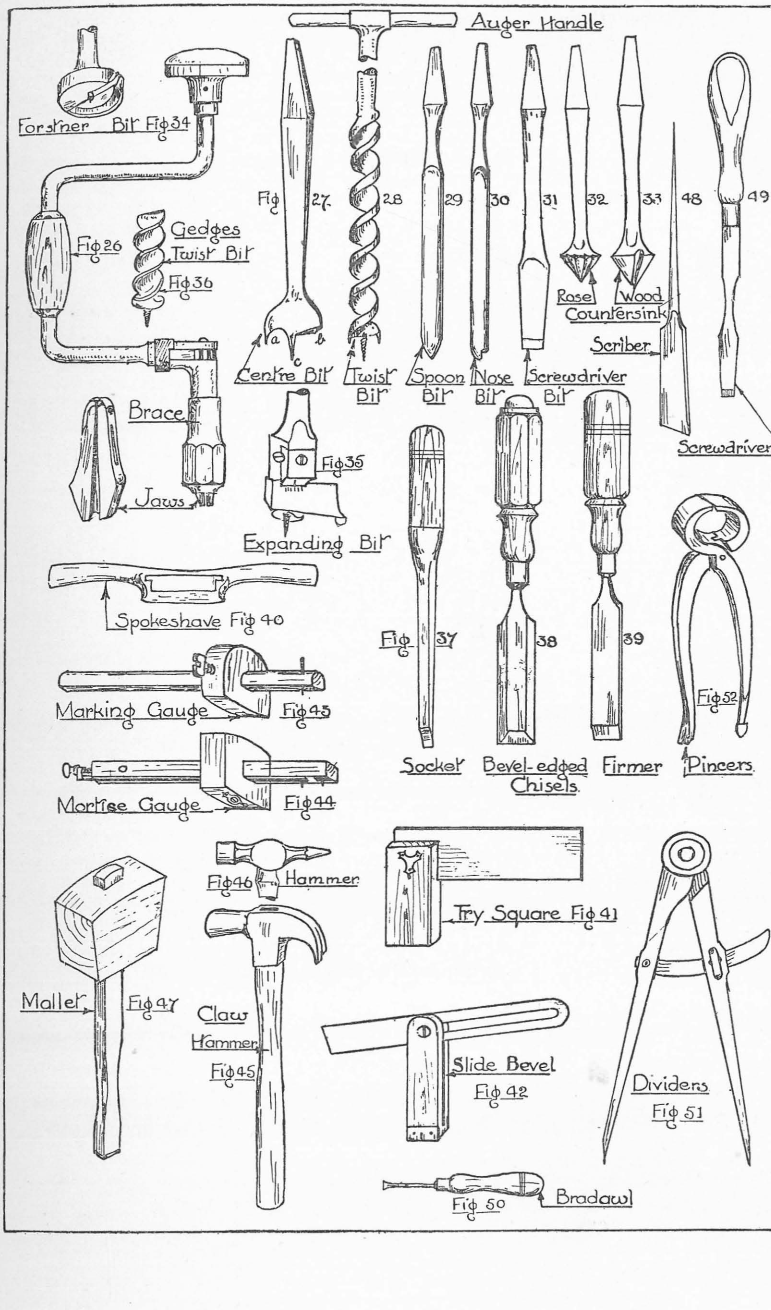
OTHER CUTTING TOOLS

Chisels.—Figs. 37, 38, and 39 show three types of chisels. The SOCKET CHISEL is used for mortising light work and for finishing the ends of mortises cut by the machine. It is made in various sizes, from $\frac{1}{4}$ in. to $\frac{3}{4}$ in. blade. The blade is extended and hollowed to form a socket into which the wood handle is fitted.

The BEVEL-EDGE CHISEL is used for paring, and the smaller sizes are used for cutting dovetails. The bevelled edges allow the chisel to be worked into corners with acute angles. The size of the chisel is denoted by the width of the blade, which is from $\frac{1}{4}$ in. to 2 in. wide.

The FIRMER CHISEL is used for all classes of work and has a stronger blade than the paring chisel. The handle should be of boxwood or beech. These chisels are ground at an angle of 25° and sharpened at an angle of 35°.

Spokeshave.—There are many types of spokeshaves, and the one shown in Fig. 40 is the ordinary wooden pattern. The blade has a flat cutting-angle and is sharpened on the inside by



Auger Handle
Forstner Bit Fig 34
Fig 26
Gedges Twist Bit
Fig 36
Fig 27.
28
29
30
31
32
33
48
49
a
b
c
Rose
Wood
Countersink
Scriber.
Centre Bit
Twist Bit
Spoon Bit
Nose Bit
Screwdriver Bit
Brace
Jaws
Fig 35
Expanding Bit
Screwdriver
Spokeshave Fig 40
Fig 37
38
39
Fig 52
Marking Gauge
Fig 45
Socket
Bevel-edged
Firmer
Pincers.
Chisels.
Mortise Gauge
Fig 44
Fig 46
Hammer
Try Square Fig 41
Mallet
Fig 47
Claw
Hammer
Fig 45
Slide Bevel
Fig 42
Dividers
Fig 51
Fig 50
Bradawl

an oilstone slip; it is held in the wood stock by two tapered tangs turned at right angles to the cutting edge. Metal spokeshaves have a blade similar to a small plane and the blade is fixed by a set-screw.

MARKING AND FIXING TOOLS

The Square.—Among the marking-out tools, the square, Fig. 41, is probably the most used. The stock is of ebony or rosewood, and the blade is riveted to the stock. A brass plate is attached to the inner edge of the stock, which thus wears much better than if left unprotected. The size of a square is denoted by the length of blade, common sizes being 4½ in., 6 in., 9 in., and 12 in.

The Slide Bevel, Fig. 42, is used for marking lines at various angles. The blade is fixed in any position by a turnscrew.

Gauges are of two kinds, the marking gauge, Fig. 43, and the mortise gauge, Fig. 44. The *marking gauge* is made of beech, and has a boxwood screw and a single steel point. The *mortise gauge* is more elaborate; it has two points, one fixed and one with screw adjustment. It has brass strips fixed in the face of the stock to prevent excessive wear. Some gauges are made with three points, for marking a mortise and a rebate at the same time, but all the three points are seldom in use at once. *Panel gauges* are made with a long stem for gauging the width of panels. The stock is fixed to the stem by a wedge.

The Claw Hammer, Fig. 45, is extremely useful, as the claw will serve in most cases for drawing nails instead of a pair of pincers. The Warrington hammer is also shown in Fig. 46.

The Mallet, Fig. 47, is made of beech. The handle is wedge-shaped and is thicker at the top; thus the swinging of the mallet tends to tighten the head, and the wedge shape prevents the head from coming off.

The Scriber or **Marking Knife,** Fig. 48, is used for marking lines, the point being used for ticking off dimensions from the rule and the knife for drawing in the lines.

The Screwdriver, Fig. 49, is of the London pattern.

The Bradawl, Fig. 50, is used for boring small holes to receive screws, nails, etc.; the fibres of the wood should be severed by placing the knife edge across the grain.

Dividers, Fig. 51, are used for spacing and for drawing circles.

CHAPTER II

WORKSHOP METHODS

IN dealing with this part of the subject, the *modern workshop* including a *machine shop* is taken into consideration, so that the *methods* and *operations* described will be closely allied to the conditions under which most craftsmen are now employed.

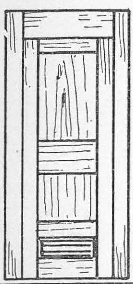


Fig 53

SHIP No. 452

40 State-Room Doors & Door Frames.

2nd - Class Accommodation

Main Deck.

Cutting List

Item	Name	No	Length	Breadth	Thickness	Material
	Door Frames					
1	Standards	80	7 ft 2"	6"	2¼"	Yellow - Pine
2	Heads.	40	3' - 2"	7¼"	2¼	" "
	Doors					
3	Stiles	80	6' - 7"	4¾"	1⅝"	" "
4	Top Rails	40	2' - 2"	4¾"	1⅝"	" "
5	Lock Rails	40	2' - 2"	9¼"	1⅝"	" "
6	Louvre Rails	40	2' - 2"	4¼"	1⅝"	" "
7	Bottom Rails	40	2' - 2"	7¼"	1⅝"	" "
	Louvre Frame			1⅝"		
8	Sides	80	6½"		⅝"	Mahogany Moulded in Length
9	Top & Bottom	80	1' - 5"	- Do -	- Do -	— Do —
10	Louvres	160	1 - 4	1⅜"	¼"	— Do —

On receiving the plans and specifications of any piece of work, the first thing to do is to " take off " a list of the material required, and make out an order for the materials from the saw-mill.

A **cutting list** is prepared similar to the one shown in Fig. 53, and the sawyer *numbers* the pieces according to the item number on the list. The sizes on the cutting list should be about $\frac{3}{16}$ in. wider, $\frac{1}{8}$ in. thicker, and $\frac{1}{2}$ in. longer than the finished sizes, to allow for planing, trueing up, etc.

It is usual to keep a copy of these cutting lists for the various stock articles, and a good way is to paste the list on a board and varnish it ; much time is thereby saved, and less errors occur.

The materials are cut on the circular saw, and are then planed on the *face and edge* and put through the *thicknessing* machine, after which they are given out to the workmen on the bench.

Trueing up the wood on the bench is the next part of the work. While the surfacing machine leaves the wood fairly true, it should be finished with jointer or trying plane for good work. The *face side* is first prepared, and *winding strips* are used to test it ; see Fig. 54, which shows the winding strips in position. In very wide stuff, such as gables and panels, it is necessary to " traverse " the surface, that is, plane across the wood at an angle with the jack plane, as shown in Fig. 55, and then finish in the direction of the grain with the trying plane.

The *face edge* is then planed square to the face side and is tested for straightness by a straight-edge. It is then ready for gauging to the required width and thickness.

Jointing.—In jointing panels, etc., the joints are numbered, and one board is fitted on the edge of the other, the boards being tested by a straight-edge, as shown in Fig. 56, to see that they lie in a *flat plane*.

Thin boards are jointed by laying them flat on the *shooting board* and shooting the edges, as shown in Fig. 57. Fig. 58 shows the method of holding the boards when coating them with glue. If the joints are of the *butt* type, the edges are rubbed together while the glue is hot ; this rubbing removes all surplus glue from the joint and excludes the air ; it is a very strong form of joint. If *Croid* glue is used, the manufacturers do not recommend rubbing, but simply placing the two boards together.

Should the boards be jointed by a tongue and groove, cross-tongue, or other similar joint, *cramps* are used to force the boards together, and to hold them until the glue is " set." Fig. 60 shows a handy method of cramping and keeping the boards straight while the glue sets. Fig. 59 shows the ordinary *sash cramp* used for the same purpose. The *handscrew* is used to hold smaller work while the glue sets, as shown in Fig. 61.

Setting Out.—A plan is provided for most work, from which

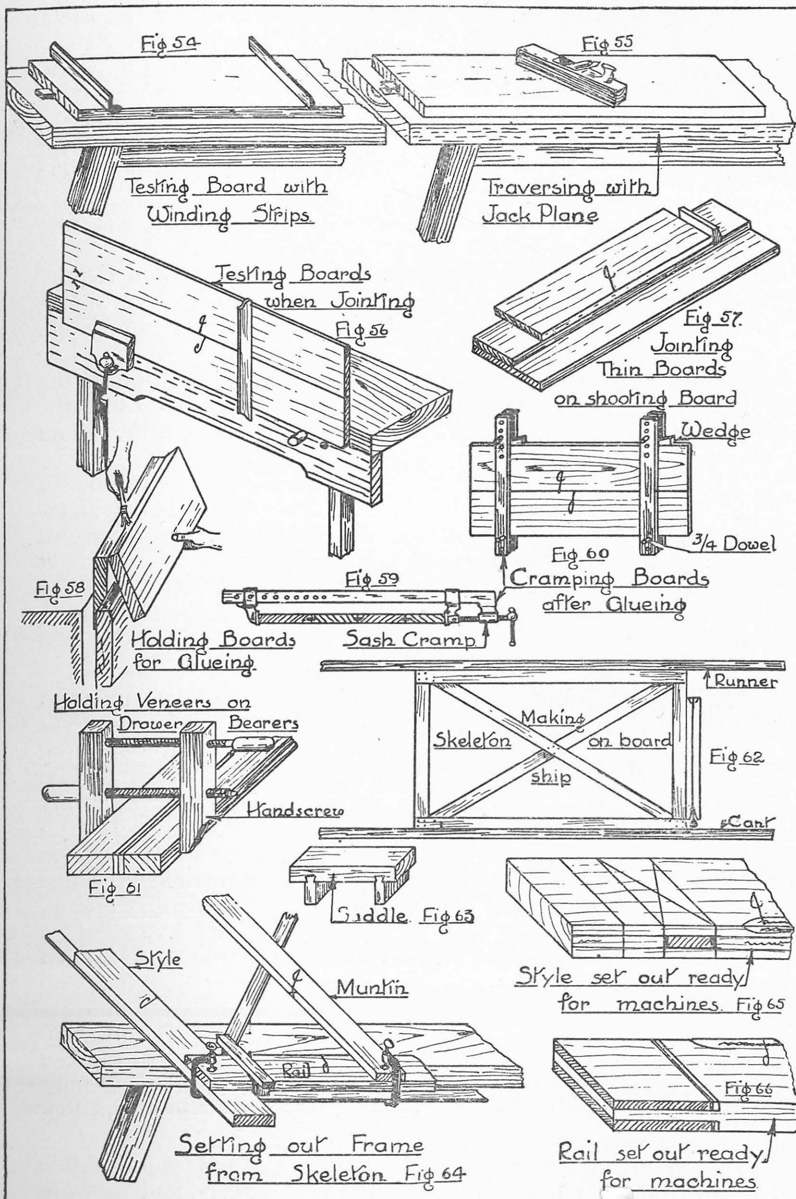


Fig 54
Fig 55
Testing Board with
Winding Strips.
Traversing with
Jack Plane
Testing Boards
when Jointing
Fig 56
Fig 57.
Jointing
Thin Boards
on shooting Board
Wedge
3/4 Dowel
Fig 60
Cramping Boards
after Glueing
Fig 58
Fig 59
Holding Boards
for Glueing
Sash Cramp
Runner
Holding Veneers on
Drawer Bearers
Making
Skeleton
on board
ship
Fig 62
Handscrew
Cant
Fig 61
Saddle. Fig 63
Style
Muntin
Rail
Style set out ready
for machines. Fig 65
Fig 66
Setting out Frame
from Skeleton Fig 64
Rail set out ready
for machines

the joiner prepares *rods* showing the *sections* and their positions *full size.* Horizontal and vertical rods are usually all that is required—with templates for circular or ornamental work. The sections are set out on pieces of $\frac{1}{2}$ in. yellow pine planed up true. Section rods for framing are set out on the ship after the cants are laid, so as to show the position and to arrange for intersecting bulkheads, position of door standards, etc. On account of the decks being curved, the bevel or necessary amount of slope is required for each piece of work; this is fully dealt with in Chapter VIII.

There are **two methods** of **setting out framing;** both require section rods as previously stated; but with regard to the shape, one method is to obtain the bevels from the beam mould and height staff and apply them to obtain the shape of each piece of framing; the other method is to make a *skeleton* on board the ship to the required size. It is not intended here to go into the merits of the two methods; the former is explained later, and the second method will now be described.

When the cants and runners are in position, a light wooden framework, as shown in Fig. 62, called a *skeleton,* is nailed together in position. This skeleton, as shown, would be a pattern for one section of framing only, and while in position the next skeleton is fitted against it, and so on until the whole passage is complete. The skeletons require to be efficiently braced, and are numbered, and their position marked on. They are then sent to the shop where the framing is prepared.

Marking out Frame from Skeleton.—The skeleton is supported in a level position on the bench, and the stiles are laid in their places, being allowed to project about $\frac{1}{8}$ in. over the skeleton sizes; this allowance is for fitting in the ship. The rails are laid on the stiles—the muntins on top of the rails, and all are firmly held in position by *thumbscrews* ready for marking out. A *saddle,* as shown in Fig. 63, is used for marking the *shoulders* on the face side of the material. Fig. 64 shows the method of using a saddle when marking the shoulder on the end of a rail. Should it be necessary to have a longer shoulder to allow for *moulding,* a strip is screwed to the edge of the saddle to extend it the required amount. Shoulder lines are all drawn with a *steel scriber,* and while the members are in position *blue lines* are drawn to indicate which sides are to be ploughed, moulded, etc. The thumbscrews are then released, the shoulders squared over and marked on the under side, and all *gauging* is done for mortises, tenons, grooves, etc. Fig. 65 shows all the markings on a *stile,* and Fig. 66 shows a *rail* as prepared for *machining.*

On account of the work being bevelled it is almost impossible to allow the tenoning machine to cut the shoulders, and they are cut in with the tenon saw on the bench.

The Setting Out of Carcases and Furniture is not so difficult, and a skeleton is not required, but only the bevel. Bevels are invariably taken from the *left-hand side facing the piece of work*, and the workman assumes this in setting out and fitting.

Front Frames for carcases are marked, and sent to the machines for mortising and tenoning; but the dovetailing and pinning of centre divisions are all done at the bench. **Drawer fronts** are fitted; the sides and backs are squared; and all are sent to the dovetailing machine.

Square and Bevel.—Fig. 67 shows a *large wooden square*, as largely used in marking out carcases. The joiner often makes his own square and the sizes are therefore given. Fig. 68 shows a large wooden *bevel*, also a most useful tool in setting out work. A method of marking out *easings* and *curved* work by a *bent lath* and panel pins is shown in Fig. 69. Fig. 70 shows a square for marking lines *normal*, or square, to a curve. The stock is made by inserting two dowels square from the marking edge of the blade and allowing them to project a little on each side. Fig. 77 shows a *banjo* used for copying curves.

Dowelling for odd jobs is done at the bench, and Fig. 72 shows a method of marking *centres* for two boards which are to be jointed. Fig. 73 shows a dowel *centre pop*. Centre pops are placed in holes previously bored, and the other part which is to be jointed is then marked by placing it on the centre pops in its correct position, and then giving a sharp tap, when the pops will mark the required centres.

The *dowel plate*, Fig. 74, is used for finishing dowels to the correct size, by driving them through the plate with a mallet. The projecting point forms an *air groove* in the dowels, which is necessary to allow the air to escape from the hole when the dowel is being driven in. A method of *cutting air grooves* in dowels made by machinery is shown in Fig. 75; a chisel is driven into the bench with a corner projecting, and the dowel is grooved by drawing it across the projecting corner of the chisel. Fig. 76 shows a *dowel sharpener*. Fig. 82 illustrates a suitable *depth gauge* to fit on the shank of a *dowel bit*; this prevents the holes from being bored too deep.

Dovetailing.—Most of the dovetailing is done by machine, but odd jobs are done at the bench.

In *setting out dovetailing* it is usual to cut the *pins first* and mark the dovetails from same, though the reverse of this is often practised. The slope for dovetails is about *one in eight*, as shown in Fig. 78, where also is shown a suitable *template*, or *templet*, for marking out same. The template is just like a tenoned rail with splayed shoulders. It is important to have the dovetails the correct slope: if they are almost parallel, they do

not hold so well ; and if the angles are too acute, the short grain of the wood is apt to fracture when the joint is being driven together. By setting 8 in. vertical, 1 in. horizontal, and joining the extreme points, as shown in Fig. 78, a good slope is obtained.

Fig. 79 shows the method of marking the dovetails, or sockets, from the pins with a scriber ; and a method of cutting out *stopped dovetails* in drawer fronts with a mallet and chisel is shown in Fig. 80.

Various types of stopped *grooves* and *tapered dovetails* in wide material are cut out as shown in Fig. 81. First, a small portion is removed near the stop by the mallet and chisel ; this allows the saw to be entered and the sides cut in to the depth. The core is then removed by a mallet and chisel and the bottom is made level by using a router.

FITTING

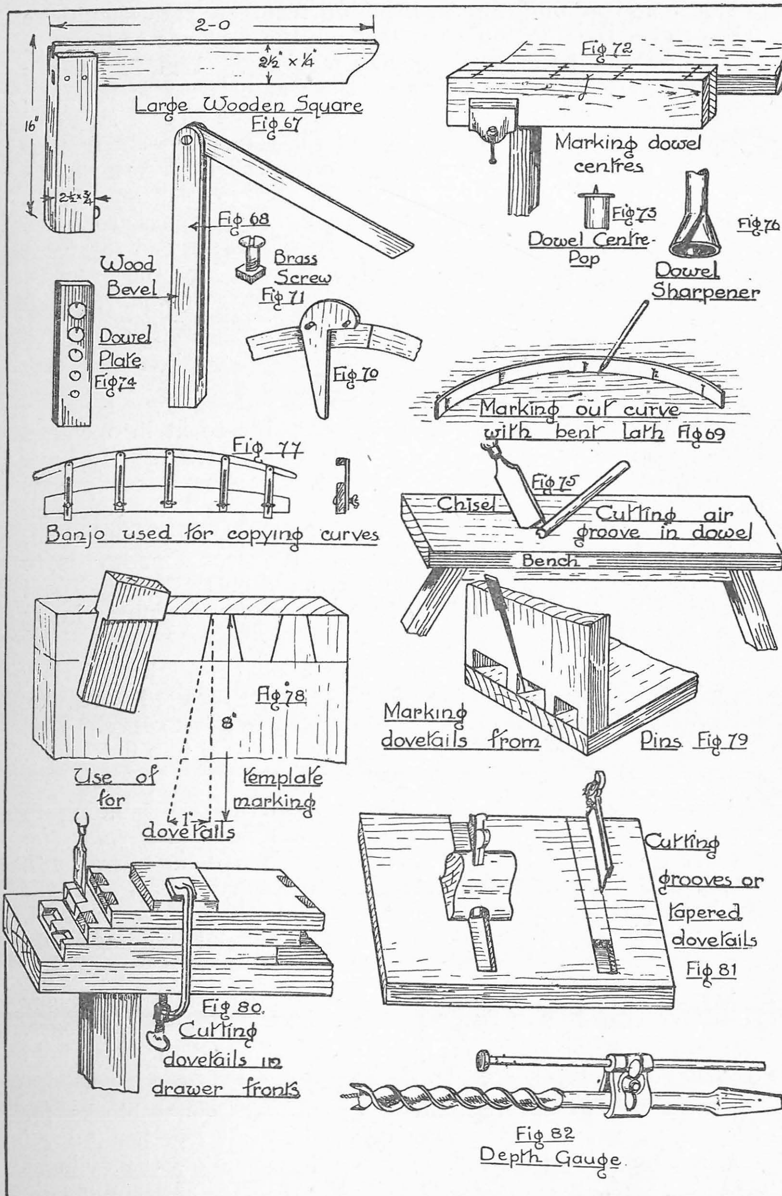
Cutting Shoulders.—The fitting of the parts together after machining requires to be carefully and accurately done. The shoulders, as previously stated, cannot be cut close to the line on the tenoning machine, and are cut back by the mallet and chisel, and finished by the shoulder plane, as shown in Fig. 83. The ends of the mortises have also to be finished with a mortise chisel ; and in cases where the mortising is done by hand, a square is placed against the face of the work to be a guide in keeping the chisel upright ; see Fig. 84.

Mitring and Scribing.—Mouldings which are *stuck* and require to be *mitred* or *scribed* are jointed with the aid of a *mitre template,* as shown in Fig. 85. The mitre template is held with the left hand and acts as a guide for the chisel in cutting the mitre. If the rail has to be scribed, the *line of intersection* can be found by first cutting it as a mitre, and then cutting away the required parts by a gouge or chisel which will suit the shape of the member.

Planting Mouldings and **Bolection Mouldings** are mouldings that are fixed in position after the framework is made ; they are cut in a *mitre box,* Fig. 86. It should be remembered, however, that very few of the mitres are exactly 45° on account of the framing not being square, but the mitre template and mitre box form an excellent guide up to a certain point.

Details in Fitting and Finishing.—The widths of tenons are marked from the mortises, and cut on the bench, or at the band saw. Fig. 87 shows the cutting out of the core for a pair of tenons.

Fig. 88 shows a type of *shooting board* with a revolving stop. This is the common shooting board for fitting planting or bolection mouldings ; a fixed stop at 45° would not be so useful as the mitres are at various angles.


2-0
2½" x ¼"
16"
2½x¾
Large Wooden Square
Fig 67
Fig 68
Wood
Bevel
Brass
Screw
Fig 71
Dowel
Plate
Fig 74
Fig 70
Fig 72
Marking dowel
centres
Fig 73
Dowel Centre-
Pop
Fig 76
Dowel
Sharpener
Marking out curve
with bent lath Fig 69
Fig 77
Banjo used for copying curves
Fig 75
Chisel
Cutting air
groove in dowel
Bench
Fig 78
8"
Use of
for
template
marking
1"
dovetails
Marking
dovetails from
Pins Fig 79
Cutting
grooves or
tapered
dovetails
Fig 81
Fig 80
Cutting
dovetails in
drawer fronts
Fig 82
Depth Gauge

When fitting joints of the framing together, care should be taken to get the different parts flush on the face side and a good intersection at the members of any moulding. Fig. 89 shows a good method of testing to see if the frame is *out of winding*. The straight-edge is pressed tightly against the face of stile and turned round to see if the face of rail will coincide. The mouldings are then *glass-papered*, Fig. 90, and wooden or cork *rubbers* are used for this purpose; the shapes are just the opposite to the shape of the member. A few of the commoner ones are shown in Figs. 91 to 94. The panels are planed and scraped to give a good surface, and the edges are planed to fit into the grooves. These are tested by a small piece of wood, called a *mullet*, which is grooved at the same time as the framing; see Fig. 96.

CURVED WORK

Forming Angles.—Frames which are made to fit in openings in steelwork, such as door frames, windows, etc., usually have the *internal angles* rounded, and Figs. 97 to 99 show three methods of dealing with same. The first method is to work the round on the *solid rail;* and, while this is a good method and often adopted, it is a little wasteful with material. The second method is to *mitre* the joint, and work part of the round on the rail and part on the stile. In the third method an *angle piece* is planted in, as shown.

Bending.—Fig. 100 illustrates a method of bending a riser for a *commode step*. A series of saw kerfs are inserted at regular intervals and allow the material to be bent to a flat curve. This method can be adopted for bending any material to a flat curve, especially when the hollow side can be hidden.

Built-up Curves.—Fig. 101 shows a method of building-up for a *curved panel;* also the method of building a *circular rim* for a table is shown in Fig. 102. The rim is made up of *segments*, which are glued and screwed together; the joints are *lapped* as shown. The surface, of course, would require to be veneered. Fig. 103 shows the same method of segmental building, only that the joints are ploughed, tongued, and splayed.

Handrail Bolts and *cross tongues* are used in jointing *circular coamings*, such as are seen in the front of a circular *deck-house*. The cross tongues make the joint watertight and the bolts hold it securely together; see Fig. 104.

Stanchion Covers are built up round octagonal blocks for turning; the joints are *cooper jointed* and put together "dry" for turning; see Fig. 105. The solid ends allow the cylinder to be rotated in the lathe. The different pieces are temporarily fixed to the blocks, and can be removed when turned to shape.

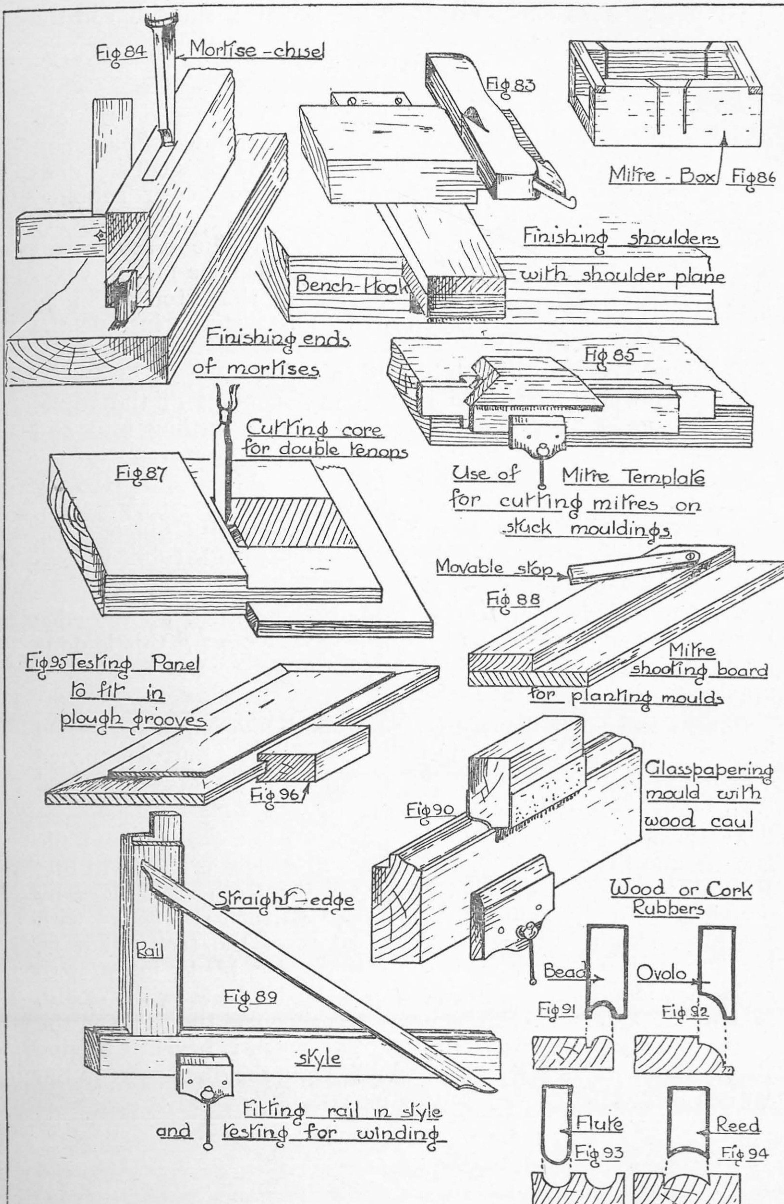


Fig 84
Mortise-chisel
Fig 83
Mitre-Box
Fig 86
Finishing shoulders
with shoulder plane
Bench-Hook
Finishing ends
of mortises
Fig 85
Cutting core
for double tenons
Fig 87
Use of Mitre Template
for cutting mitres on
stuck mouldings
Movable stop
Fig 88
Mitre
shooting board
for planting moulds
Fig 95 Testing Panel
to fit in
plough grooves
Fig 96
Glasspapering
mould with
wood caul
Fig 90
Straight-edge
Wood or Cork
Rubbers
Rail
Bead
Ovolo
Fig 89
Fig 91
Fig 92
skyle
Fitting rail in style
and testing for winding
Flute
Reed
Fig 93
Fig 94

They are polished and built up round the steel stanchion in the ship.

SHARPENING TOOLS

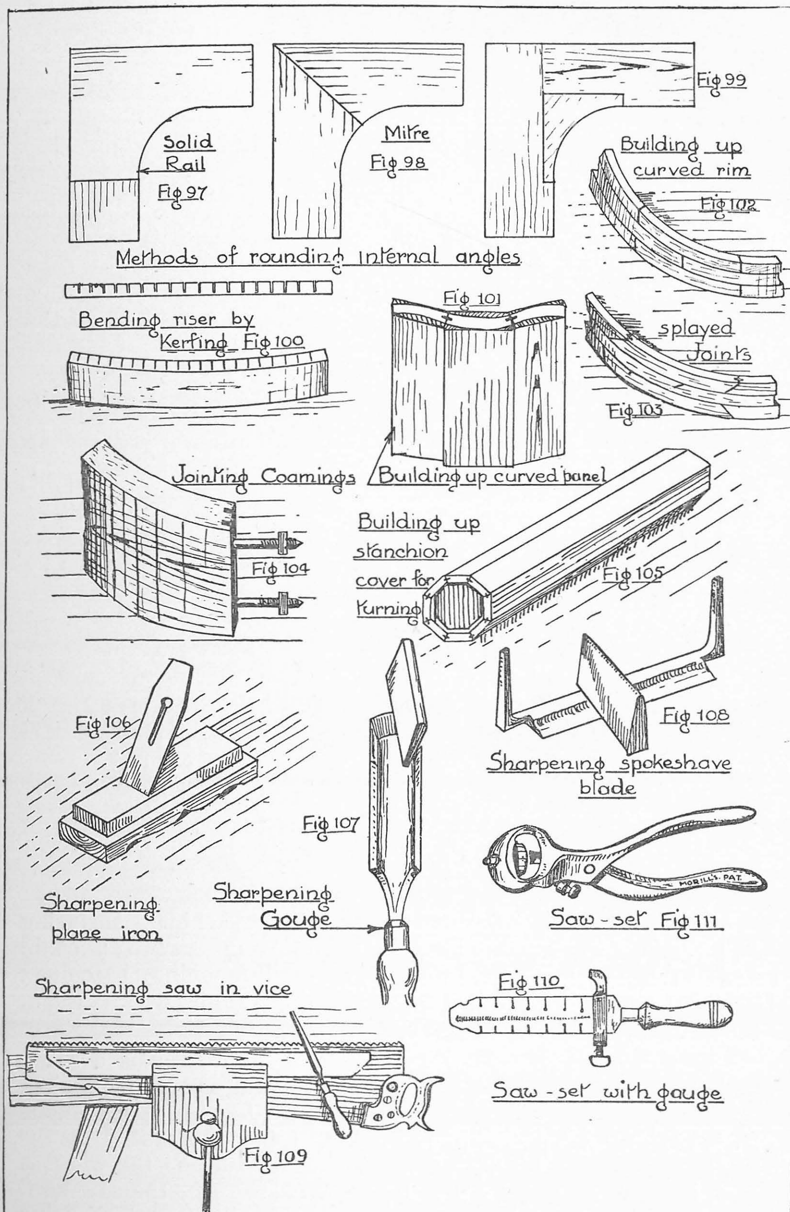
Oilstones.—Plane irons and chisels are sharpened on the oilstone, as shown in Fig. 106. There are several kinds of oilstones, some *quick cutting* and some *slow cutting*. The slow cutting ones leave a finer and sharper edge but require longer rubbing. *Natural oilstones* vary a good deal in texture and some cut quickly while others are slow cutting. They include the Washita and Turkey stones. *Artificial stones*, however, can be had in varying and *definite* degrees of coarseness, so that stones can be bought to suit special requirements. These stones include the Carburundum and Indian.

Oil should be used as a lubricant, and it should be of such a quality as will not set and harden in the pores of the stone. A *cover* should be provided to prevent dirt settling into and clogging the pores of the stone. The oilstone often wears hollow and requires to be periodically straightened; this is done by holding it on the side of a grindstone; or the straightening can be done effectively on a board covered with rough glass-paper, to which water is applied while the stone is rubbed backwards and forwards.

Grinding.—Chisels and plane irons become thick at the edge by constant sharpening, and require to be *ground*; this is done by holding them on a revolving grindstone, to which water is applied.

Gouges and Spokeshave.—Inside ground gouges are sharpened by an oilstone slip as shown in Fig. 107, and the " burr " is turned on the ordinary oilstone. Spokeshave blades are sharpened by a similar slip, Fig. 108.

Sharpening Saws.—In sharpening saws a three-cornered file is used, and the saw is fixed by *clamps* in a vice, as shown in Fig. 109. Prior to sharpening, the tops of the teeth are *levelled* by drawing a flat file along them. They are then sharpened with the file and afterwards *set*. The *setting* of the teeth, that is, bending the teeth over from the plane of the blade, in order to make a wider kerf in the wood for the blade to work easily, is done by a *saw-set*. Two types are shown. In Fig. 111 the teeth are pressed against a circular disc which is bevelled to give varying amounts of set, so that by revolving the disc any required set can be given.


Solid
Rail
Fig 97
Mitre
Fig 98
Fig 99
Building up
curved rim
Fig 102
Methods of rounding internal angles
Bending riser by
Kerfing Fig 100
Fig 101
splayed
Joints
Fig 103
Jointing Coamings
Building up curved panel
Fig 104
Building up
stanchion
cover for
turning
Fig 105
Fig 106
Fig 108
Sharpening spokeshave
blade
Fig 107
MORILL'S PAT.
Sharpening
plane iron
Sharpening
Gouge
Saw-set Fig 111
Fig 110
Sharpening saw in vice
Saw-set with gauge
Fig 109

CHAPTER III

JOINERS' MACHINES

MACHINERY plays an all-important part in the modern workshop, and in order for the workman to adjust his methods and utilise the machines where possible, it is necessary for him to have a knowledge of the type of work done by each machine. This chapter, in addition to being valuable in this way to the man at the bench, will also be of assistance to the machinist.

The following is a list of joiners' machines, and it is proposed to illustrate and describe the more important ones: circular,

— CIRCULAR SAW BENCH —

Fig 113 One Deep

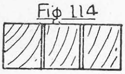
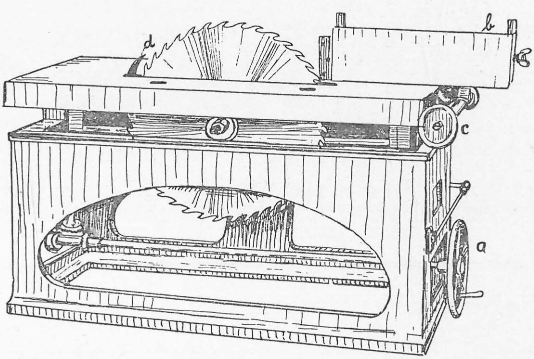


Fig 114 Two Flat

FIG 112



band, and jig saws; four-cutter moulding machine; surfacing and thicknessing machine; spindle moulding machine; chain and square-cutter mortising machine; tenoning machine; machine for checking ship's gratings; dovetailing, deck-planing, dowelling, and sand-papering machines.

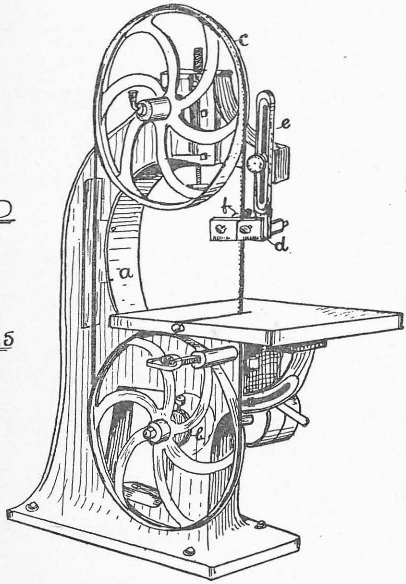
The Circular Saw.—The saw shown in Fig. 112 has a rising and falling table, and is adapted for general sawing, tonguing, grooving, and rabbeting. The speed of the teeth is about 10,000 ft. per minute. The rising and falling table is operated by the wheel *a*, and the fence *b* can be adjusted by turning the wheel *c*. A riving knife *d* is fitted behind the saw to open the saw kerf, and prevent the wood gripping on the back of the saw and being

thrown back against the operator. Figs. 113 and 114 illustrate the terms *deep* and *flat*. One deep means a cut in the direction of the depth which leaves equal thicknesses of material. A 30-in. saw would have about 1,100 revolutions per minute.

Band Saw.—Fig. 115 is a sketch of a band saw. It is made up of a large **U**-shaped casting *a* of box form, the lower part of which is fitted with bearings and shaft *b* for the bottom saw pulley. The upper saw pulley *c* runs freely on a shaft, which can be raised or lowered to adjust the *tension* in the saw. This shaft and bearing can also be *tilted* so as to obtain perfect alignment of the two saw pulleys. The rims of the saw pulleys are covered

BAND SAW

FIG 115



Saw-blade

Fig 116

with vulcanised rubber for the protection of the saw teeth. The table can be tilted for cutting circular work on the bevel.

Adjustable wood guides *d* are fitted to the suspended arm *e*, and prevent the saw from twisting when cutting quick curves; directly behind is an anti-friction roller *f* to take the pressure on the back edge of the saw. A similar roller is also fitted underneath the table.

The speed for 30-in. saw pulleys would be 400 revolutions per minute and for 36-in. pulleys 350 revolutions. An enlarged view of the bandsaw teeth is shown in Fig. 116. The pitch of the teeth vary according to the width of the saw: for example, a $\frac{1}{8}$-in. blade will have nine teeth per inch; $\frac{1}{4}$-in. blade, about six; and 1-in. blade, three teeth; and so on.

The Jig Saw, Fig. 117, is used for cutting fretwork and outlines of quick curvature. The saws are from $\frac{1}{16}$-in. wide upwards, and can be easily attached to the slide bar *a* to enable them to be inserted through a hole for *internal cutting*. The vertical motion is obtained by a crank *b*, and the saw is kept in tension by strands of rubber *c*. The upper part of the machine is steadied by iron stays *d*. The table can be *canted* for cutting bevelled work, being held in any desired position by the quadrant shown. The speed of the shaft is 600 revolutions per minute. Typical work done by the jig saw is shown in Figs. 118 and 119.

- JIG - SAW -

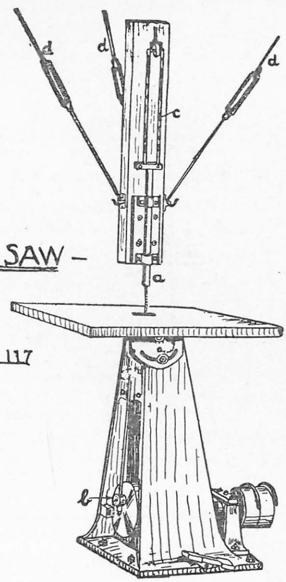


FIG. 117

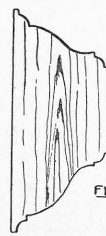


FIG. 118

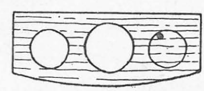


FIG. 119

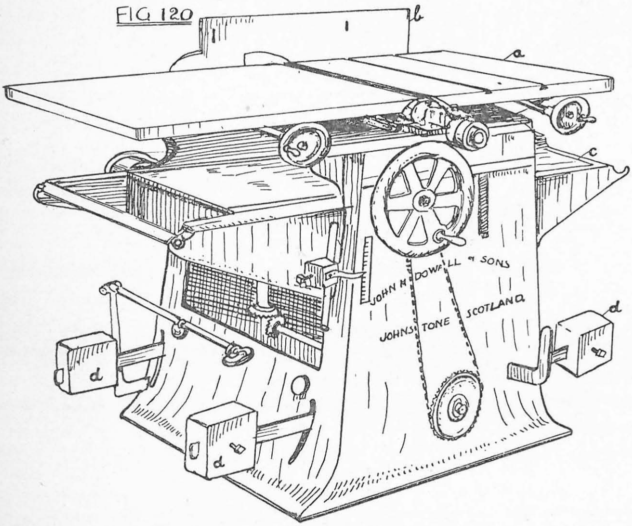
Surface Planing and Thicknessing Machine.—Fig. 120 shows a most useful combination machine which, in addition to surfacing and thicknessing, can be used for jointing and moulding. The upper table *a* is used for surfacing; that is, producing a level surface. The work is passed over from right to left, and sometimes two springs assist in holding the work tightly against the table; the vertical fence *b* gives a support to the timber when the edges are being planed. The table is in two parts, and the right-hand one is kept lower than the left-hand one by the *depth* of the *cut*. *Surfacing* is probably one of the most dangerous operations and a *guard* should be kept over any part of the cutters not in use. A *telescopic* guard, which can be extended or contracted as desired, is suitable.

When "thicknessing," the lower table c can be raised or lowered to suit the size of material. The material is drawn through by feed rollers. The top feed rollers have levers and weights d attached to their bearings to give the necessary pressure and to yield to the inequalities of the timber being fed into the machine.

The circular cutting action of the knives tends to leave wave-like undulations on the surface of the wood, and to reduce this defect to a minimum the diameter of the cutting circle should be as small as possible and the cutters should revolve at a high and uniform speed. The speed of the spindle is about 3,500 revolutions per minute.

— PLANING MACHINE —

FIG 120

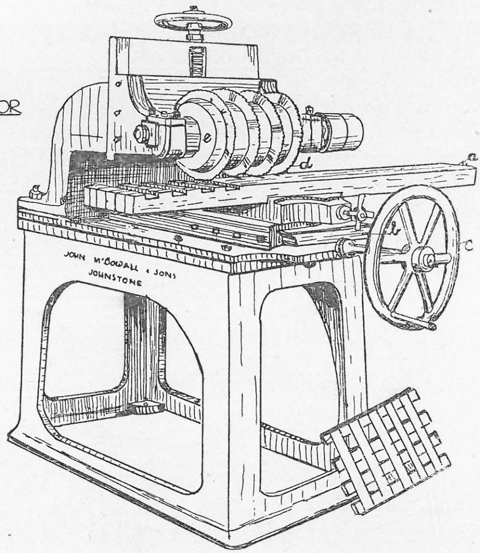


Machine for Checking Ship's Gratings.—This machine, Fig. 121, cuts out the checks in the pieces required for making gratings. Gratings are largely used on board ships: this special type of machine is therefore here included. Several pieces can be cramped together as at a, and the cramp is moved forward in grooved slides b by means of a wheel and screw c. The cutting action is by "drunken" saws d, set to the proper angle on the spindle by bevelled collars e, these saws being so arranged that the *width* of checks and the *distance* left between them are exactly equal. The shaft and saws can be raised or lowered to give any depth of cut, by the wheel and screw at the top of the machine. The table has a *swivel* motion for diagonal grooving.

Combined Chain and Hollow Chisel Mortising Machine.—This machine, Fig. 122, is adapted for *general mortising* in both

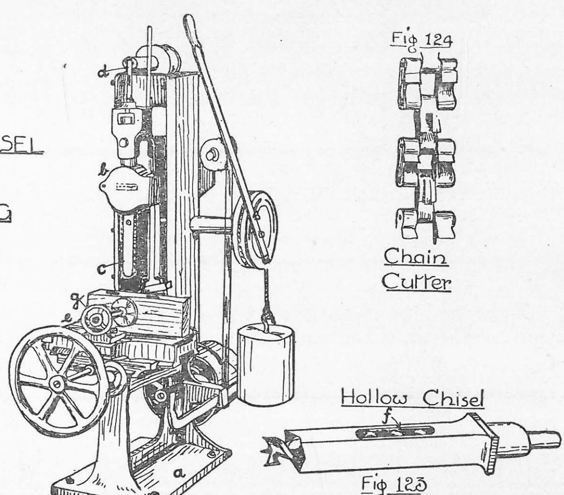
MACHINE FOR CHECKING GRATINGS

FIG 121



CHAIN AND HOLLOW CHISEL MORTISING MACHINE

FIG 122

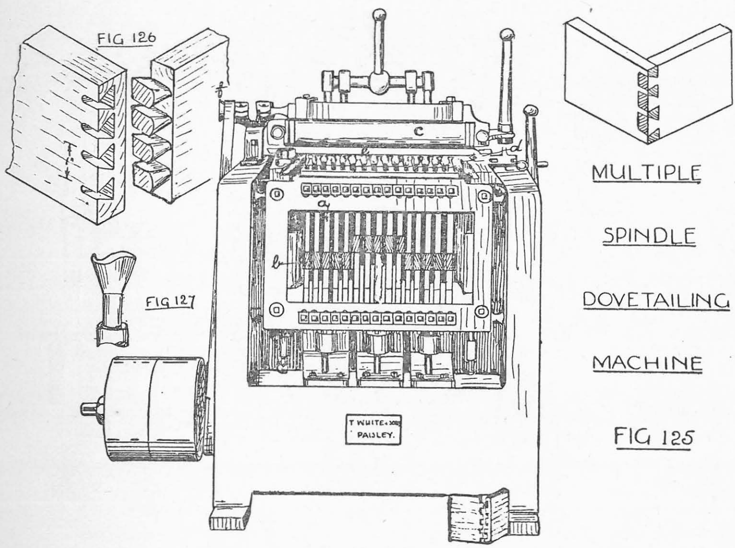


hardwoods and softwoods. It is composed of a main frame *a* and headstock *b*, the latter carrying the chain *c* and hollow chisel *d*. The timber being mortised rests on table *e*.

The headstock is arranged to revolve so as to bring either the *chain* or *chisel* into operation, as desired. The chisel is used for *short* mortises where the chain would be too wide. Varying sizes of chains can be had to mortise from $\frac{1}{4}$ in. to 1 in. wide, and from $1\frac{1}{2}$ in. to $2\frac{1}{2}$ in. long. The hollow chisel has a *revolving auger*, Fig. 123, rotating inside it; the cuttings escape from aperture *f*. The material is fixed in position by a screw cramp *g*; and the table has longitudinal motion by rack and pinion, and lateral motion by screw.

Fig. 124 shows an enlarged sketch of a chain for mortising.

Dovetailing Machine.—The machine shown in Fig. 125 is a



MULTIPLE SPINDLE DOVETAILING MACHINE

FIG 125

machine of the *multiple spindle type*. The spindles *a* are driven from the main shaft by *raw-hide bevelled gear*, and thence to *spiral gears b* attached to the cutter spindles. This spiral form of gear runs smoothly and uniformly.

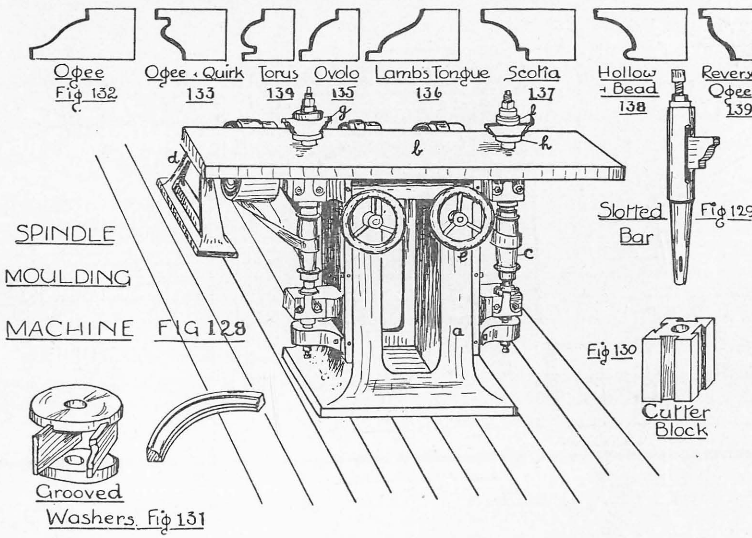
The *clamps c* to hold the wood are of the eccentric form, thus quickly fixing the wood in position. Two boards are placed in the machine together, and the *carriage d* is then brought forward over the *cutters e* when the dovetails are cut. If a *round end* is required on the pins, this can be done by a side movement which passes the wood around the cutters.

The dovetails can be made to any degree of tightness by raising or lowering the frame containing the spindle bearings.

Dovetails can be cut 1 in. *pitch*, which is the regular size, or

by a special combination machine either ½ in. or 1 in. pitch. The pins and dovetails in machine work are all the same size. Fig. 126 shows a sketch of the type of work done by this machine. A small emery wheel *f* for grinding the cutters is fitted to the machine. An enlarged sketch of one of the cutters is shown in Fig. 127.

Vertical Spindle Moulding Machine.—An almost endless variety of work can be done on this machine, but it is chiefly confined to "sticking" mouldings on the solid and for jointing boards. The illustration, Fig. 128, shows the spindles with fence removed, as required for *circular work*.



The *main frame a* is of cast iron and the *table* part *b* is planed. The *spindles c* are driven from a *countershaft d*, and a rising and falling motion is imparted to the spindles by means of screw and *handwheel e*.

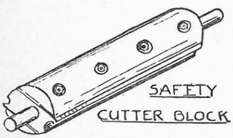
The top ends of spindles are fitted with *grooved washers f* to receive and hold the cutters *g*, but for heavier mouldings *square cutter blocks* are used. The three methods of holding cutters are shown in Figs. 129 to 131. The *slotted*, or *French* spindle is largely used, and gives a good finish to the work, on account of the small periphery of the revolving moulding cutters.

The wood is fed by hand and is pressed against a washer *h* on the spindle which acts as a fence or guide for the depth of cut, but when the whole edge of the wood is to be moulded or

cleaned up, a template of the required shape is used for pressing against the washer.

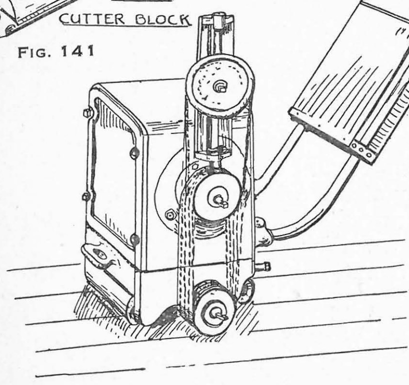
Figs. 132 to 139 show a selection of stuck mouldings usually worked on the spindle. The speed of the spindle is about 3,000 revolutions per minute.

Deck Planing Machine.—Until recently the decks were all planed by hand. The joiner had to work on his knees, planing



SAFETY CUTTER BLOCK

FIG. 141



DECK PLANING MACHINE

FIG 140

and scraping to make the decks smooth; but with the introduction of the machine shown in Fig. 140 this irksome work has been largely avoided. This machine is driven by electricity and does its work quickly and well, leaving only awkward corners to be finished by hand. The driving of the machine requires about three horsepower and will plane a width of 12 in.

In Fig. 141 is shown a *circular safety cutter block*. The cutter block is $4\frac{1}{8}$ in. diameter and the cutting periphery $4\frac{1}{4}$ in. diameter.

CHAPTER IV

DECK-HOUSE CONSTRUCTION

SITUATION.—Deck-houses are erections on the *weather deck*, for the purpose of giving additional accommodation, and do not form part of the general structure of a vessel. A deck-house is fitted in most vessels about *midships*, or slightly forward of amidships, where the steam steering gear is housed in the *wheel-house;* an extension abaft is used as a *chart room*.

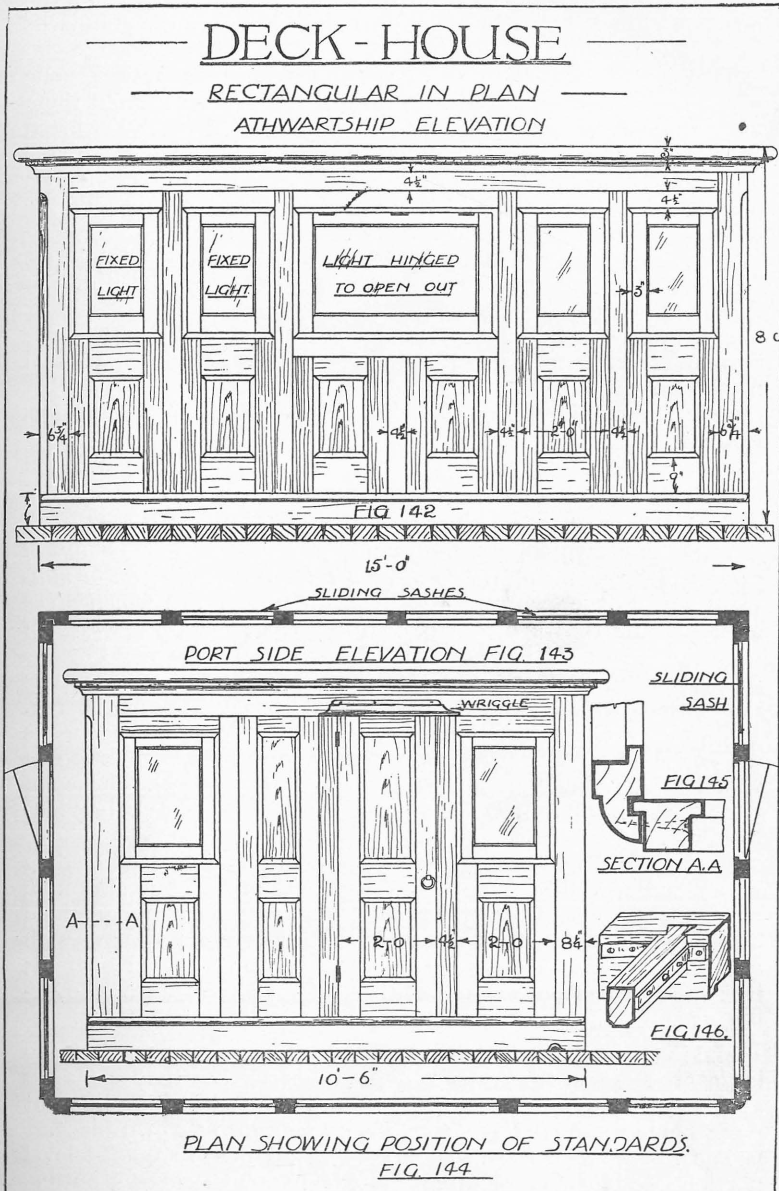
Types of Deck-Houses.—There are three forms of construction, and the size of the house usually determines what form will be adopted: (*a*) all steel; (*b*) composite—part steel and part wood; or (*c*) all wood, with brass fittings. The latter form is usually adopted for small houses. Wood construction is most suitable in the vicinity of the ship's compass, as steel has a magnetic attraction on the needle; hence it is a rule *not to place any steelwork within a* 10-*ft. radius of the compass*, the fittings being usually of brass on account of its non-magnetic properties.

The Wood Deck-House consists of a heavy or *main* framework, with lighter or *secondary* framing to fill in the spaces. The heavy framing is made up of a stout piece bolted to the deck and known as the *coaming*, with vertical *standards* placed about 2 ft. 6 in. centres and *stringer* framed to the standards. The spaces between the standards are filled in with light framing, or *sheeting*, and the inside is lined with tongued and grooved sheeting.

The main framework in a composite house is of steel, with steel coaming, angle-iron standards, and deck beams, the intervening spaces being fitted with *grounds*, and the whole covered with a double thickness of tongued and grooved sheeting.

Deck-House with Straight Front.—Figs. 142 to 146 give the drawings of a deck-house with a straight front and a rectangular plan. The house is well lighted and is used as a combined *wheel* and *chart* house. Some of the sashes are made to slide and some are fixed, as will be seen in plan, but the one in the centre of the deck-house front is made to open out. This sash is made particularly large in order to give the man at the wheel a good "look out." It is hung at the top by brass butt hinges, and a *rule-jointed quadrant stay* is fitted at each side to hold the sash when open.

The main framing consists of a 10 in. by $3\frac{1}{2}$ in. coaming, with a $\frac{3}{4}$-in. bead worked on its upper edge; the standards are 6 in.


DECK-HOUSE
RECTANGULAR IN PLAN
ATHWARTSHIP ELEVATION
FIXED LIGHT
FIXED LIGHT
LIGHT HINGED TO OPEN OUT
3"
4½"
4½"
3"
8' 0"
6¾"
4½"
4½"
2' 0"
4½"
6¾"
9"
FIG 142
15'-0"
SLIDING SASHES
PORT SIDE ELEVATION FIG. 143
WRIGGLE
SLIDING SASH
FIG 145
SECTION A.A
A---A
2-0
4½
2-0
8¼"
FIG 146.
10'-6"
PLAN SHOWING POSITION OF STANDARDS.
FIG. 144

by $3\frac{1}{4}$ in. and rebated to receive the framing and stringer; the latter is $7\frac{1}{2}$ in. by $3\frac{1}{4}$ in., and rebated and jointed to the standards by a mortise and tenon joint.

Two doors are arranged to open out on to the deck—one *port* and one *starboard*—and cabin hooks are fitted to hold them back against the deck-house when open. A " wriggle " is fitted over the doorway to prevent any water running down the side of the house from entering the door joints; a water groove on its front upper edge carries the water to the outer edges of the door opening.

Fig. 145 shows the joint between the two corner standards. It is a *tongue* and *ovolo* joint, and is screwed from the inside of the rebate before the framing is fitted between.

Fig. 146 shows the section and joint of an *intermediate stringer;* two brass *angle pieces* are fastened to same by screwing and bolting to give additional strength.

In order to allow any water to escape which might find its way into the deck-house, two holes are bored through the coaming on a level with the upper surface of the deck. Typical vertical sections through sliding sashes are shown in Fig. 150.

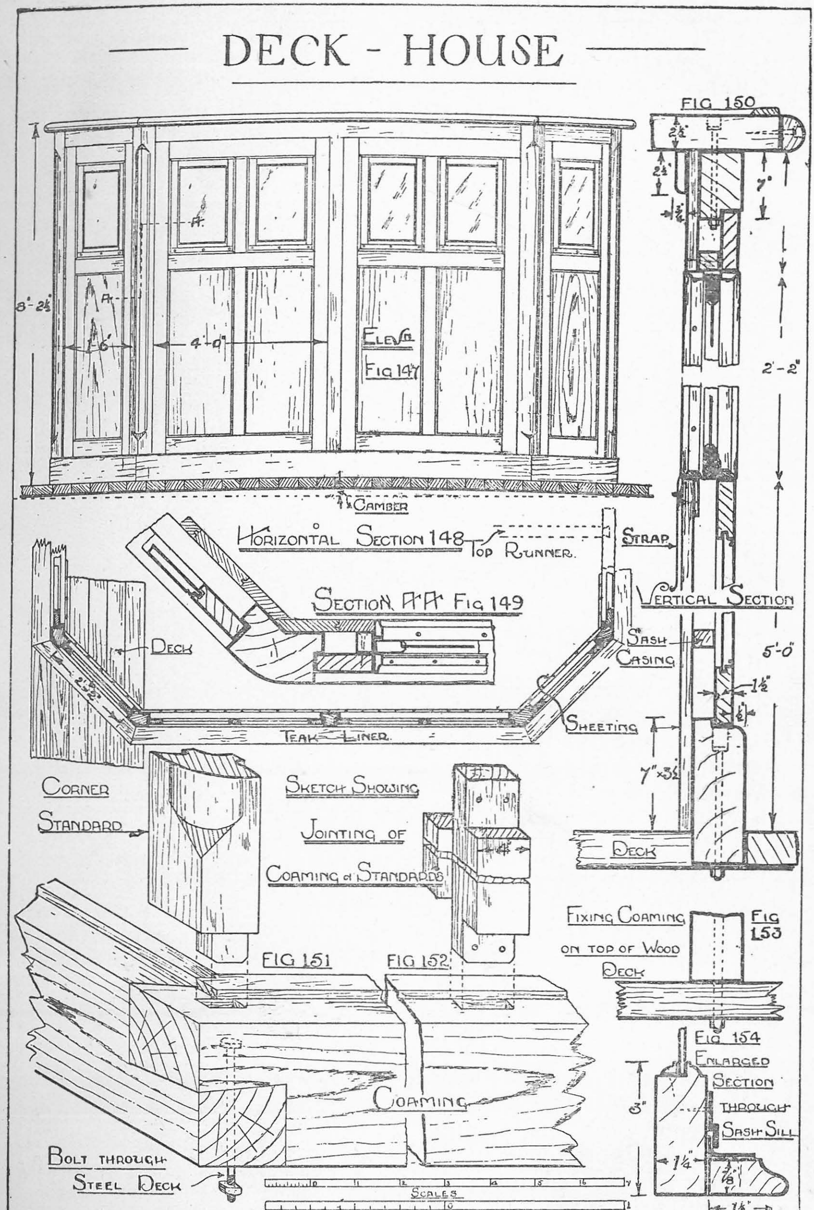
Deck-House with Break Front.—The elevation in this particular example is drawn to suit the *camber* of a deck. *The amount of camber or " round up " is taken as a $\frac{1}{4}$ in. per ft. of beam at midships,* and in the example a 30-ft. beam is assumed, which gives a rise at the centre of $7\frac{1}{2}$ in. However, in the total width of deck-house shown, the rise in the centre only measures 2 in.

The main framework is much the same as in the last example; only the *corner standards* are solid in one piece, as shown in Fig. 149, which is a vertical section on *AA* in Fig. 147. All the sashes are made to slide in the front of the house, a plan section of which is shown in Fig. 148. The plan of the house is not completed, as it will follow much the same lines as the previous example.

The vertical section, Fig. 150, shows the method of dealing with a sliding sash. A casing is fitted between the outer framing and the sheeting on the inside in which the sash slides, and moulded linings make out the opening. The sash is not balanced with weights, but has a *strap* and *stud* to hold it in any desired position; it is made watertight at the sill by two brass plates which overlap, as shown in Fig. 154.

Making and Fixing Deck-House.—Deck-houses, when not too large, are made in the joiner's shop; when finished they are taken apart and again fitted up in position aboard ship, the different parts being numbered to ensure each going into its own place.

The following is the usual **procedure** adopted: A good level portion of a floor is required, on which is marked the outline plan of the house. The coamings are then prepared, being


DECK - HOUSE
FIG 150
2'-2"
5'-0"
8'-2½"
1'-6"
4'-0"
ELEVN
FIG 147
CAMBER
HORIZONTAL SECTION 148
TOP RUNNER.
STRAP
SECTION "A" "A" FIG 149
VERTICAL SECTION
DECK
SASH CASING
SHEETING
TEAK LINER.
CORNER STANDARD
SKETCH SHOWING JOINTING OF COAMING & STANDARDS
DECK
FIXING COAMING ON TOP OF WOOD DECK
FIG 153
FIG 151
FIG 152
FIG 154
ENLARGED SECTION THROUGH SASH SILL
COAMING
BOLT THROUGH STEEL DECK
SCALES

machine-planed to size. They are then marked, and cut to the camber at the band saw, being finished to shape by spokeshaving, the rebate being cut on the spindle. They are now ready for jointing. Two forms of joints are shown in Figs. 151 and 155. The former is known as the *ship-lap*, or *carpenter's dovetail*, and is a form of double dovetail with a rebate on the internal angle to make the joint watertight; the latter is similar to ordinary box dovetailing, with a rebate on the internal angle, and an iron dowel is driven down through the joint. The joints are then fitted. The pieces cut off at the band saw to form the camber are used to pack up the coamings to the required position.

The standards are cut to the required section and tenoned into the coamings. An ovolo or round is worked on the corner standard, Fig. 149, and the stringer is tenoned into the corner standards and mortised to receive the intermediate ones.

With the heavy framing in position, the size and bevels for the lighter framing can be obtained, and the framing is made and fitted while the house is in position. The casings and sashes are also prepared and fitted. Practically everything is made portable and in sections, so as to be easily removed to the ship, and all the parts should be distinctly marked when being taken apart.

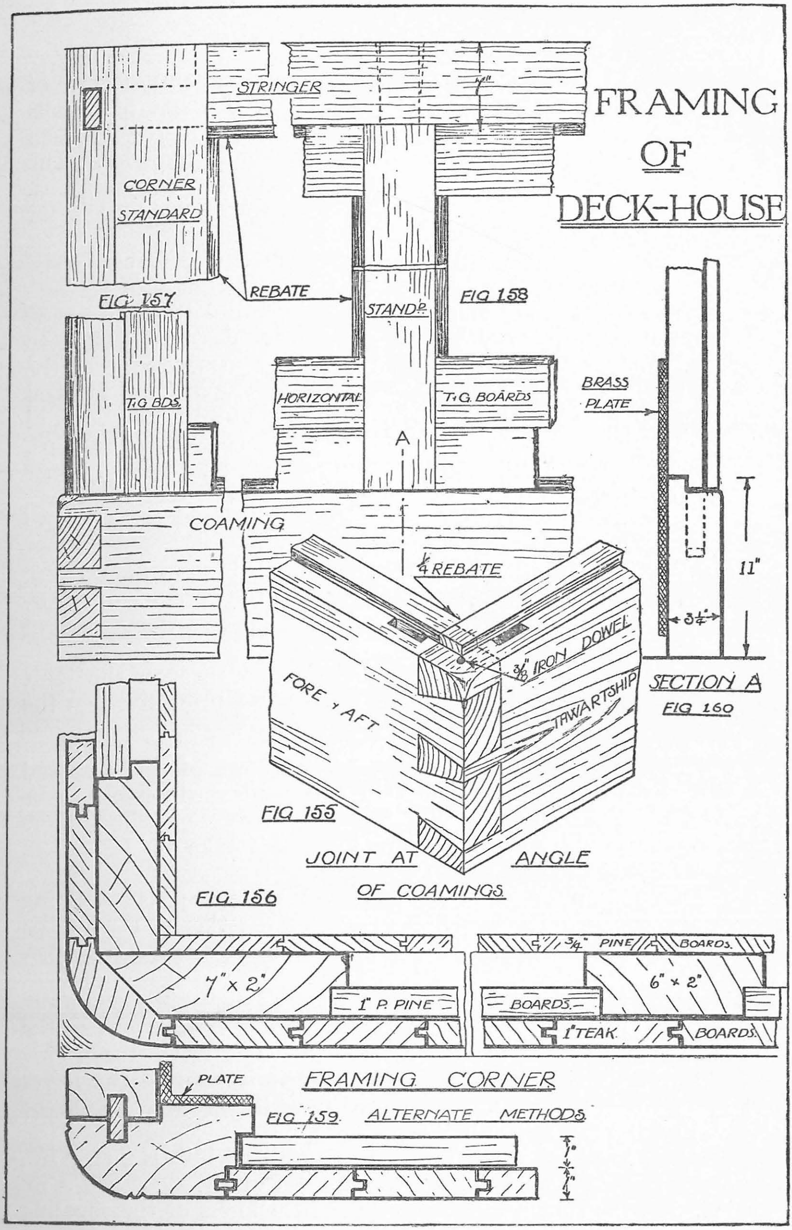
In fitting up in the ship the coamings are first bolted in position. Figs. 150 and 153 show two methods of doing this. The former is the common method: to bolt the coaming directly to the *steel* and to fit and caulk the deck round it. It is essential that the coaming be well fixed to the deck on account of the heavy weather and high winds these houses have to withstand.

There is a tendency for deck planks around deck-houses to rot quickly owing to the large amount of water constantly dripping down the sides of the house, and to prevent this, where yellow pine planks are used, a piece of teakwood is fitted to the outside and the deck planks are butted against it. Teakwood, of course, is much more durable than yellow pine in damp positions.

When the *framework* of the house has been erected, the covering, or shade deck, is fixed. The deck planks are fastened down with large wood screws or bolts, and the heads sunk below the surface and plugged. The joints are *caulked*, to make them watertight, with oakum and pitch or marine glue, and the deck ends are finished with a half-round nosing.

The inside of the house is finished with tongued and grooved sheeting, and a half-runner is fitted to cover the joint between the shade deck and sheeting.

In good work, deck-houses are made entirely of teak, but pitch-pine is often used instead. All the joints should be painted with lead paint coloured to suit the wood, and where possible should be strengthened by brass plates.


FRAMING
OF
DECK-HOUSE
STRINGER
CORNER STANDARD
REBATE
FIG 157
STAND^D
FIG 158
T.G. BDS.
HORIZONTAL
T.G. BOARDS
BRASS PLATE
A
COAMING
¼ REBATE
⅜" IRON DOWEL
FORE & AFT
THWARTSHIP
11"
3¼"
SECTION A
FIG 160
FIG 155
JOINT AT ANGLE OF COAMINGS
FIG 156
7" x 2"
1" P. PINE
¾" PINE BOARDS.
6" x 2"
BOARDS.
1" TEAK BOARDS.
PLATE
FRAMING CORNER
FIG 159. ALTERNATE METHODS

DETAILS OF DECK-HOUSE

Framing of Deck-house.—The construction and forms of deck-houses are so varied that an additional sheet of details has been supplied. These details are of houses entirely finished by sheeting and not by framing as in previous examples. The main framing is exactly the same as that previously described. Fig. 155 gives an alternate joint to the one shown in Fig. 151 for the jointing of coamings.

Fig. 156 shows the plan at the angle of a deck-house. The main framework is rebated to receive one thickness of tongue-and-groove sheeting, which is of pitchpine, and on the outside is nailed a layer of teak boards. A special piece is worked to form a round corner as shown ; this piece also covers up the tenons at the corners of the main framing. The inside is finished with $\frac{3}{4}$-in. yellow pine sheeting. Fig. 157 shows the elevation of this arrangement. The stringer is tenoned into the angle standard, and is mortised to receive the intermediate standards ; the upper part shows the jointing with the *boards removed,* and the lower part shows the boards in *position.* Fig. 158 shows the arrangement in connection with a centre standard.

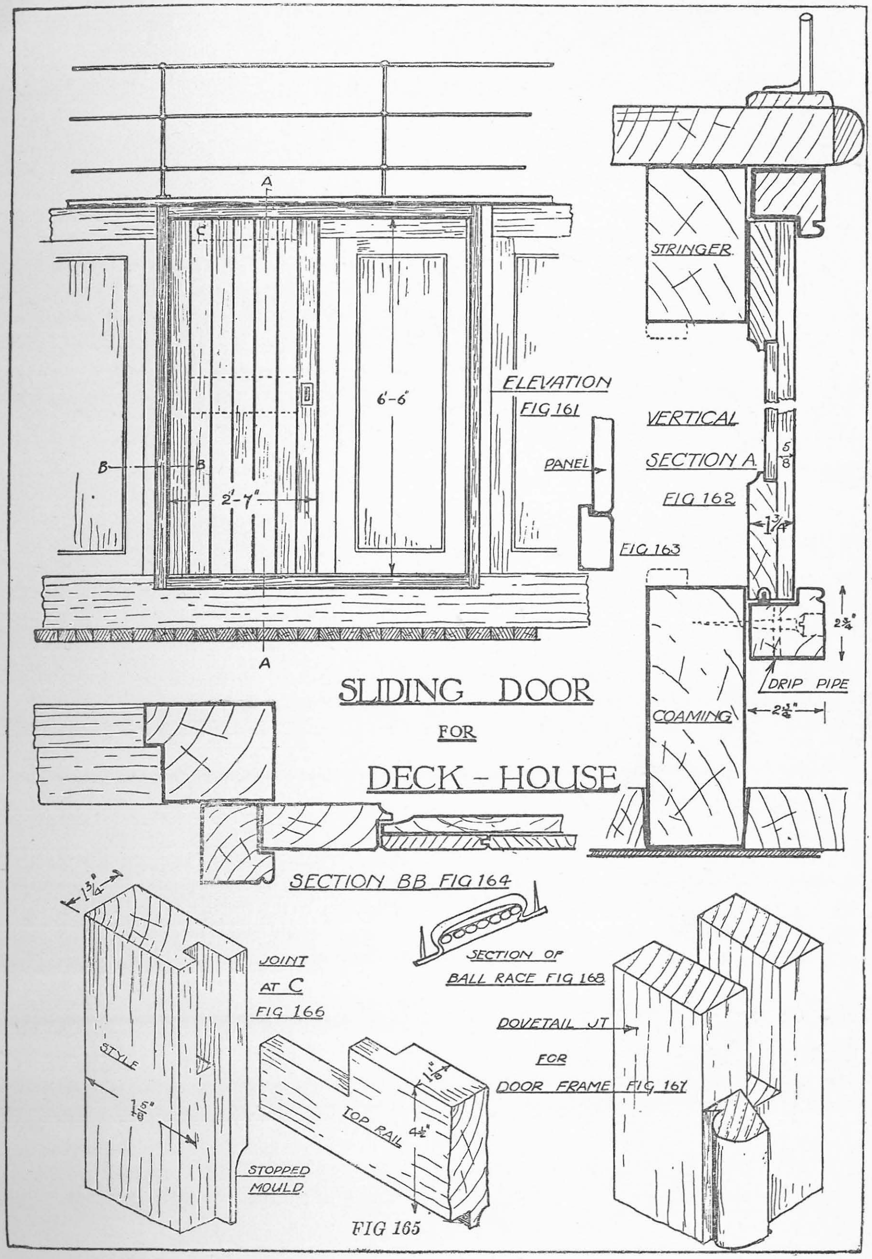
An alternative method of treating the angle is shown in section, Fig. 159, where the sheeting is stopped at the corner standards, while a double rebate is formed to receive the two thicknesses of sheeting.

Section *AA*, Fig. 160, shows the section through the joint between standard and coaming, a brass plate being fixed on the inside.

Sliding Door for Deck-house.—On account of the exposed positions of deck-houses, the doors are particularly liable to be broken off the hinges by high winds ; therefore, sliding doors are in many cases adopted. Sliding doors take up less room on the deck than those which open out.

The accompanying drawing illustrates an example of a sliding door and frame. The frame is dovetailed together at the angles, as shown in sketch, Fig. 167, and is rebated to receive the door. Its width would be $\frac{1}{2}$ in. less than twice the width of the door. It is screwed to the face of the deck-house, as shown in the section, Fig. 162. Two standards are spaced so as to come opposite the stiles of the door frame. The frame is carried up to the nosing of the deck-house ; but in cases where it is kept to the lower edge of the stringer, a capping, with water groove, should be nailed on the top rail and allowed to project.

The height of the door is 6 ft. 6 in. and its width is 2 ft. 7 in., showing 2 ft. 6 in. the clear. The stiles of the door are 2 in. thick, and the rails are thinner by the thickness of the sheeting


A
C
B
B
2'-7"
6'-6"
A
ELEVATION
FIG 161
PANEL
FIG 163
STRINGER
VERTICAL
SECTION A.
FIG 162
5/8
1 3/4
2 3/4"
DRIP PIPE
2 1/2"
COAMING
SLIDING DOOR
FOR
DECK - HOUSE
SECTION BB FIG 164
1 3/4"
JOINT
AT C
FIG 166
STYLE
1 5/8"
STOPPED
MOULD
TOP RAIL
1 5/8"
4 1/2"
SECTION OF
BALL RACE FIG 168
DOVETAIL JT
FOR
DOOR FRAME FIG 167
FIG 165

on the face; in this case the sheeting is $\frac{5}{8}$ in. thick, so the rails are $1\frac{3}{8}$ in. thick. The joints in the sheeting are chamfered to form a **V**, and the same chamfer is run on the door stiles to joint in with the sheeting; see Fig. 164.

The door slides on a metal rail, shown in section *A*, and *ball runners*, a section of which is shown in Fig. 168, are sunk into the bottom rail. A groove is cut in the bottom rail so as to clear the metal rail. The rebate on the bottom rail forms a recess for water, as it runs down the face of the door, and *drip pipes* are fitted, through holes in the rail, to carry away the water. The rebated portions in the doorway, that is, on the stringer and coaming, are cut away to form a clear opening. The inside of the door has a scotia mould; the jointing of top rail, Fig. 165, is shown in Fig. 166.

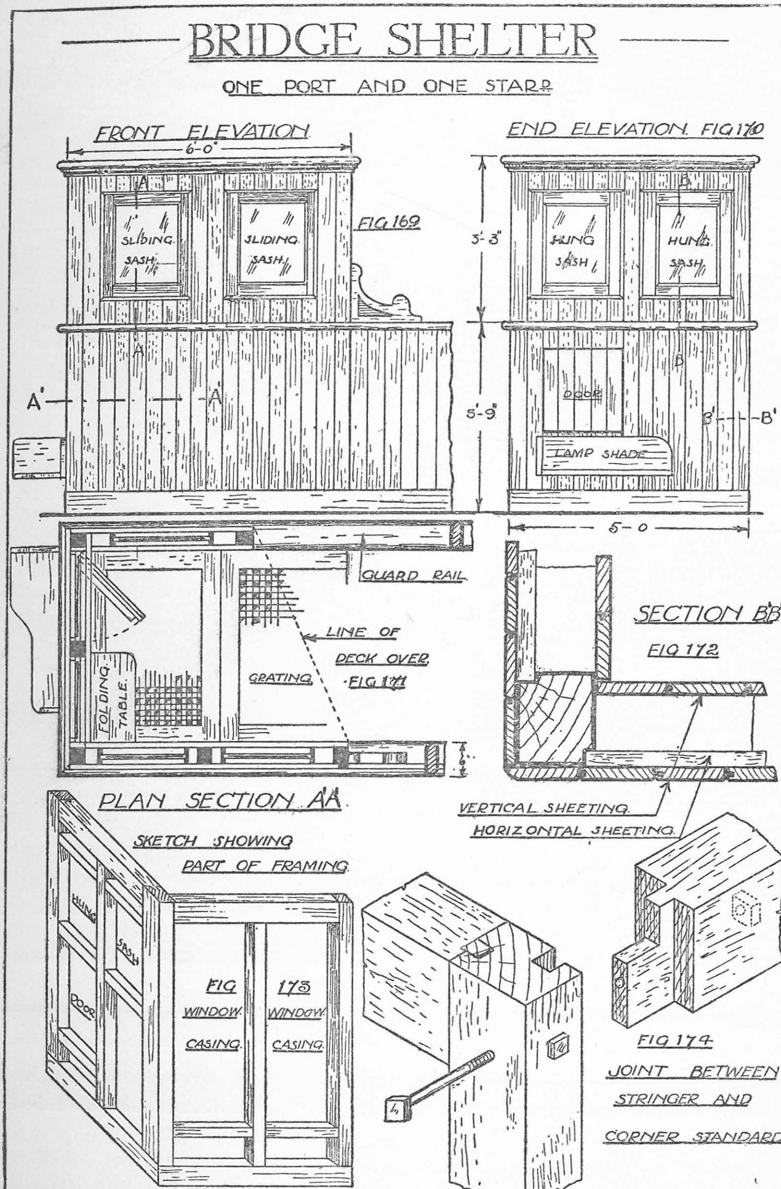
BRIDGE SHELTER OR DODGER.

General Construction.—Two of these shelters occupy the extreme ends of the *flying bridge* and are provided in all large boats. They offer protection from wind and bad weather and are much appreciated by men on watch. They also assist the men in getting a "clear view." Instead of this type of wood shelter, sometimes an awning is stretched over wood spars carried on iron stanchions. Windows are arranged on the three closed-in sides; those athwartship are made to slide and the two fore-and-aft ones are hung at the top. On account of the door to the lamp shade it is not possible to arrange for these fore-and-aft sashes to slide; hence the alternative arrangement of hanging them to open in.

The door in the side of the shelter is necessary for the trimming and cleaning of lamps, which are carried one on the port and one on the starboard side; and in order for the man on watch to see if the lamps are burning properly a small hole is bored right through the door just opposite the lamp. The deck inside the shelter is covered with *grating*, as shown in plan, Fig. 171; this is much drier for the men to stand on in wet weather. Also a *folding table* is supplied, which is supported on a *gallows bracket* and can be dropped down when not in use. This table is used for entering particulars into a temporary logbook.

The *main framework* is built up much in the same way as an ordinary deck-house, with coamings, standards, and stringers. Sometimes it is covered with sheeting and sometimes the spaces are fitted with framing.

The guard rail is butted against the shelter, and the nosing is continued all round to imitate a continuation of this rail *A*. A *bracket* is fitted in the angle between the guard rail and shelter for ornamental purposes.


BRIDGE SHELTER
ONE PORT AND ONE STARB
FRONT ELEVATION
6'-0"
SLIDING SASH
SLIDING SASH
FIG 169
END ELEVATION. FIG 170
3'-3"
5'-9"
HUNG SASH
HUNG SASH
DOOR
LAMP SHADE
5-0
A'
A
B
B'
GUARD RAIL
LINE OF DECK OVER
GRATING
FIG 171
FOLDING TABLE
SECTION B'B'
FIG 172
PLAN SECTION A'A
VERTICAL SHEETING
HORIZONTAL SHEETING
SKETCH SHOWING PART OF FRAMING
HUNG
SASH
DOOR
FIG 173
WINDOW CASING
WINDOW CASING
FIG 174
JOINT BETWEEN STRINGER AND CORNER STANDARD

The *after* framing of the shelter is not so wide as the *forward* framing because less protection from wind is required, and in many cases this diminution of width is necessary to allow for a *ladderway* to the deck below ; the top of the shelter is then splayed to suit the different sizes of framings.

Fig. 173 is a sketch of the framing showing the openings as left for windows—sliding and hung—and door. Fig. 174 shows a method sometimes employed for fastening the two stringers to a solid angle standard ; of course, other methods are also adopted, as shown in previous deck-houses.

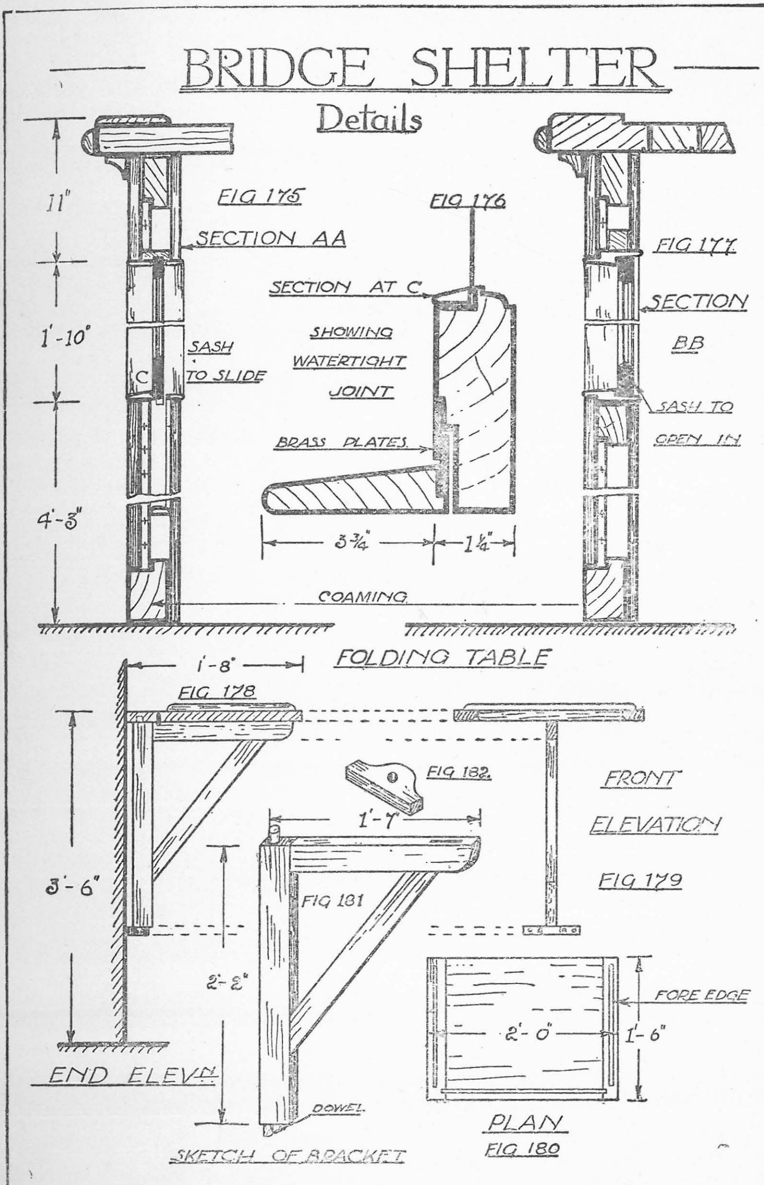
The general features of this shelter are shown in Figs. 169 to 174 and the sizes are marked on the drawings. It is important to note that this part of the bridge fitting is subject to high winds and is in a particularly exposed position : hence it should be constructed in a very thorough manner, and the joints should be well fitted.

Bridge Shelter Details.—Figs. 175 to 177 show sections of the bridge shelter described in the previous drawings. Section *AA*, Fig. 175, shows the arrangement for a sliding sash ; a light casing is housed together and fitted between the outer and inner thicknesses of sheeting, and rubber stops are nailed to the bottom rail. The joint at the sill is shown enlarged in Fig. 176 and is made watertight by two brass plates, one fixed in a rebate on the sash sill, and one on the frame sill. The casing is made so much higher to allow of the one being lifted over the other. A strap is fixed to the sash for the purpose of raising it and holding it in any desired position.

Section *BB* shows another arrangement through a hung sash. A moulded and rebated frame is fixed to the standards and rough framework, into which the sash is fitted. It is hung at the top, and held open against the deck above by *tower bolts*. A section is also shown through the cover or shade deck, and the raised wash-board is worked on the solid in this section, whereas in section *AA* it is planted on. The top is often covered with canvas, which is held down by nailing a slip along the rebate in the wash-board.

The sheeting on the outside is of a double thickness, the inside portion of which is horizontal and of pitchpine, while the outside thickness is vertical and of teak. The sheeting on the inside of the shelter is vertical and is carried right down to the deck.

Table.—Figs. 178 to 182 show a folding table such as is fitted inside a shelter. This form of table is also used in many other parts of a ship. Fig. 178 shows the end elevation and Fig. 179 the front elevation. The table is made of teak and fitted with a small fore-edge all round. The leaf is clamped at the ends,


BRIDGE SHELTER
Details
FIG 175
SECTION AA
11"
1'-10"
4'-3"
SASH TO SLIDE
C
FIG 176
SECTION AT C
SHOWING WATERTIGHT JOINT
BRASS PLATES
3 3/4"
1 1/4"
FIG 177
SECTION BB
SASH TO OPEN IN
COAMING
FOLDING TABLE
1'-8"
FIG 178
3'-6"
END ELEVN.
FIG 182.
1'-7"
FIG 181
2'-2"
DOWEL.
SKETCH OF BRACKET
FRONT ELEVATION
FIG 179
FORE EDGE
2'-0"
1'-6"
PLAN
FIG 180

and is hinged to a $2\frac{1}{2}$ in. by 1 in. piece which is screwed to the framework inside. It is supported when in use by a *gallows* bracket, framed up, as shown in Fig. 181. This bracket is arranged to revolve by cutting two dowels on the vertical piece, to fit into holes, one in the piece to which the table is hinged, and one in a small bracket screwed to the inside sheeting. The general sizes are shown on the drawing, and the illustrations should make the construction quite clear.

Lamp Shade.—The purpose of a lamp shade is twofold: firstly, to support the lamp at the port and starboard sides; and secondly, to shade the light so as to satisfy the BOARD OF TRADE REGULATIONS with reference to these lights. The following is the regulation to be complied with:

A steam vessel when under weigh shall carry:

(a) *On the starboard side a green light so constructed as to show an unbroken light over an arc of the horizon of ten points of the compass; so fixed as to throw the light from right ahead to two points abaft the beam on the starboard side; and of such a character as to be visible at a distance of at least 2 miles.*

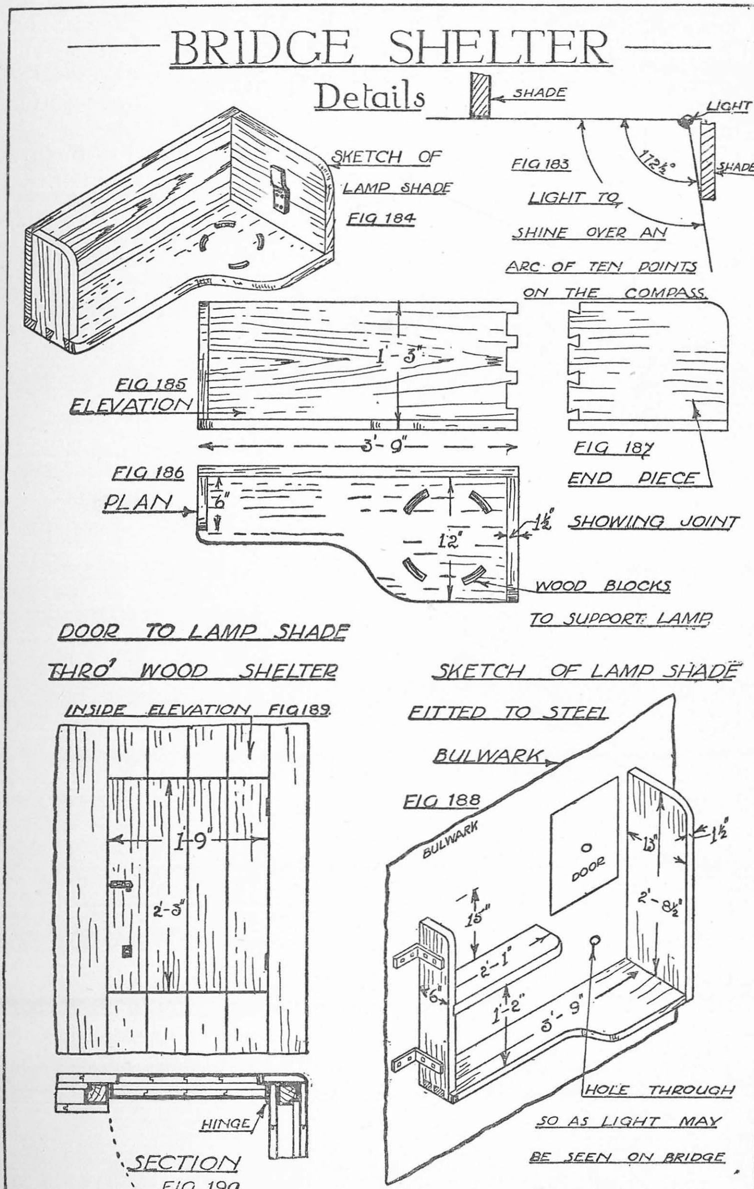
(b) *On the port side, a red light, etc.*

(c) *The said green and red side lights shall be fitted with inboard screens projecting at least 3 feet forward from the light so as to prevent these lights from being seen across the bow.*

Fig. 183 shows the respective positions of the light to the *screens*, or *shades*. The *forward screen* is right ahead of the light, and the after one is arranged to screen off the light so as to show two points abaft the beam. The *mariner's compass* is divided into thirty-two parts, or points, so that one point on the compass equals $360 \div 32$, or $11° \; 15'$; ten points thus are equal to $112\frac{1}{2}°$. By this means the *position* of the lamp can easily be ascertained after the lamp shade is made, or if necessary the position of the lamp can be fixed and the *after screen* arranged to suit.

Fig. 184 shows a sketch of a lamp shade for a wood shelter. The after screen and back are dovetailed together, and the forward screen and bottom are dovetailed together, the other parts being screwed. The bottom is shaped to suit the sizes of the screens, and *blocks* are screwed to the bottom to keep the lamp clear of any moisture. Various sizes of lamps are used, but of late they are chiefly electric lamps, 7 in. to 10 in. diameter.

When electric lights are used, an auxiliary oil lamp is carried, and is often fastened to the small door through the side of the


BRIDGE SHELTER
Details
SHADE
LIGHT
SHADE
FIG 183
172½°
LIGHT TO SHINE OVER AN ARC OF TEN POINTS ON THE COMPASS.
SKETCH OF LAMP SHADE
FIG 184
1'-3"
FIG 185
ELEVATION
3'-9"
FIG 187
END PIECE
SHOWING JOINT
FIG 186
PLAN
6"
1½"
12"
WOOD BLOCKS TO SUPPORT LAMP
DOOR TO LAMP SHADE THRO' WOOD SHELTER
INSIDE ELEVATION FIG 189.
1'-9"
2'-3"
SKETCH OF LAMP SHADE FITTED TO STEEL BULWARK
FIG 188
BULWARK
DOOR
13"
1½"
2'-8½"
15"
2'-1"
6"
1'-2"
3'-9"
HINGE
SECTION
FIG 190
HOLE THROUGH SO AS LIGHT MAY BE SEEN ON BRIDGE

shelter. This can then be used in the event of the electric power failing.

Fig. 188 shows a lamp screen fitted to a steel bulwark. The screen is designed and constructed in the same manner as the previous one, except that it has no back, and is held in position by galvanised iron lugs.

Figs. 189 and 190 show the elevation and section through a door which gives access to the lamp shade. It is made up of two thicknesses of sheeting, which are nailed to two horizontal ledgers. It is hinged, and fitted with a tower bolt and cabin hook, which holds it back against the after framing when open.

CHAPTER V

FLYING BRIDGE AND FITMENTS

PLAN of Flying Bridge.—It is outside the scope of this work to deal with the planning or arrangement of fittings on the different parts of a ship. Yet it is a distinct advantage to the craftsman to have a general knowledge of the arrangement of the different rooms; therefore a plan is here included of a *flying bridge*, and while scarcely any two vessels would have the same plan, they practically all require similar fittings.

On the bridge shown in Fig. 191 there are no large deck-houses, but the entire bridge is covered in by awnings supported on spars, as indicated by dotted lines. These spars are supported on iron stanchions with cup heads to receive the ends of same. There are two dodgers, or bridge shelters, one port and one starboard, the roof line of which is indicated by dotted lines.

There is a steering wheel and compass on the fore-and-aft centre line, also a grating; this grating will not be shown in detail as it greatly resembles the *leadsman's platform*, only that instead of the metal fittings it is raised from the deck by four brass washers and is fixed to the deck. Its size is 2 ft. 6 in. by 2 ft. A plan is also shown of a skylight over the smoke-room; this skylight is dealt with in detail in the chapter on skylights.

The whole of the bridge is symmetrical, that is, the port and starboard fittings are the same. These fittings include: two bucket racks for holding fire buckets, two boxes for life-belts, and two fresh-water tanks. A guard rail encloses the bridge, and two ladders lead up from the bridge below. Binocular and telescope boxes, fastened to the front of the bridge, complete the list of wood fittings.

Plan of Upper Bridge.—Some of the features not connected with joinery-work on this bridge, Fig. 192, have been omitted in order to make this work more clear; for example: lifeboats, davits, and metal ventilators have been omitted.

The accommodation includes *chart-room* and *wheel-house, captain's quarters*—that is, day-room, state-room, and bath-room—and a *smoke-room* and *bar* used by passengers. The chart-room furnishings include: chart table, flag locker, book-case, seat and locker, steering wheel, and compass; there are two doors leading out on to the deck and one into the captain's day-room.

The furnishings of the *captain's day-room* include: knee-hole desk, chair, bookcase, safe, table and seat, and sofa. The

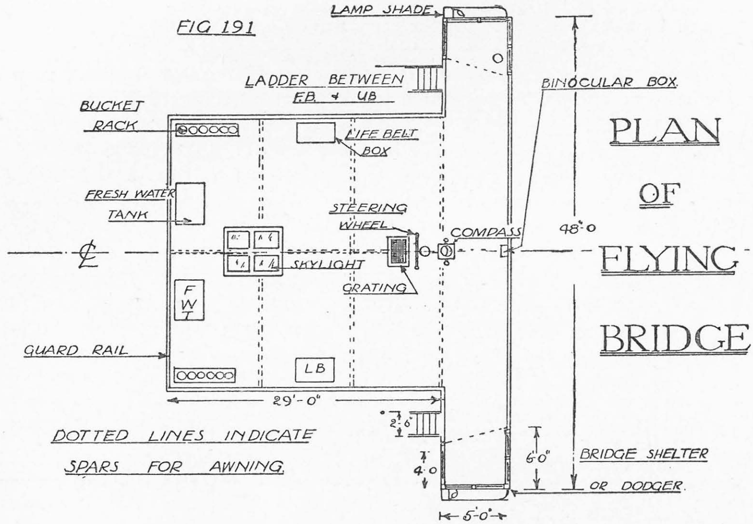


FIG 191

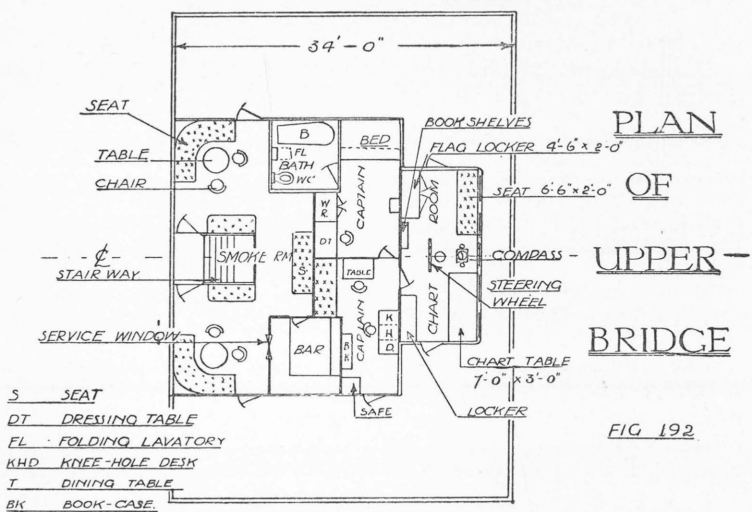
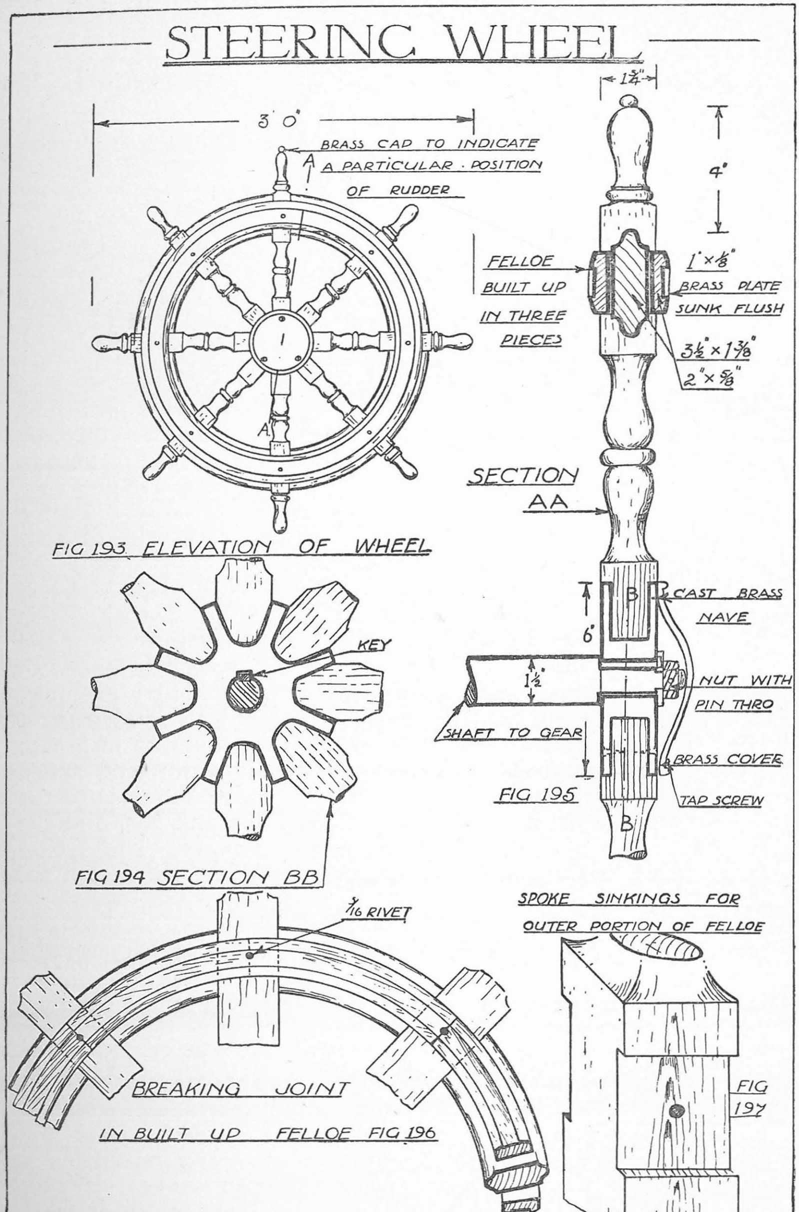


FIG 192


STEERING WHEEL
3' 0"
BRASS CAP TO INDICATE A PARTICULAR POSITION OF RUDDER
A
A
FIG 193. ELEVATION OF WHEEL
KEY
FIG 194 SECTION BB
1¾"
4"
FELLOE BUILT UP IN THREE PIECES
1" × ⅛"
BRASS PLATE SUNK FLUSH
3½" × 1⅜"
2" × ⅝"
SECTION AA
CAST BRASS NAVE
B
6"
1½"
NUT WITH PIN THRO
SHAFT TO GEAR
BRASS COVER
TAP SCREW
FIG 195
B
5/16 RIVET
BREAKING JOINT IN BUILT UP FELLOE FIG 196
SPOKE SINKINGS FOR OUTER PORTION OF FELLOE
FIG 197

state-room fittings are : telescopic or extending berth with drawers under, wardrobe, dressing-table with chair, and folding lavatory.

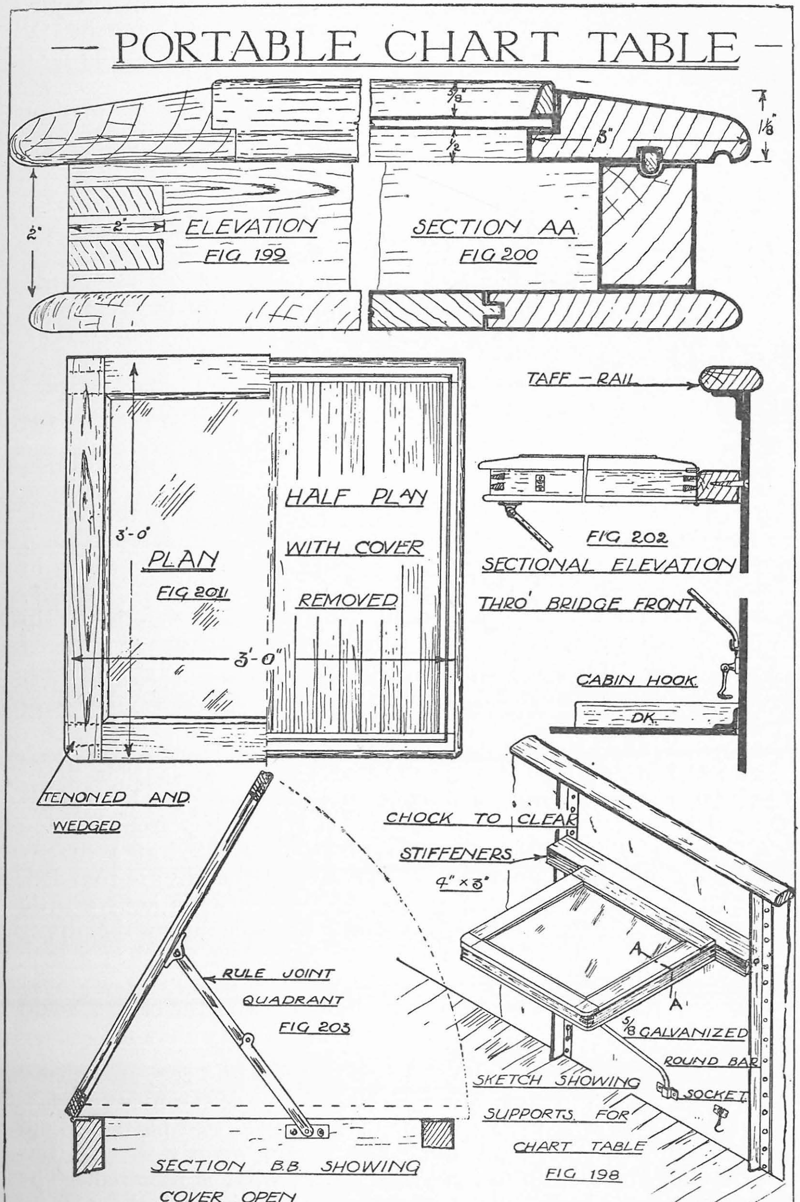
Aft of the captain's quarters are a *bar*—with service window, *counter* and *bottle rack ;* and *smoke-room* with the usual fittings—seats, tables, and chairs. The stairway is enclosed and entered by swing doors. Two doors also lead off on to the deck. These doors, it will be noticed, open to the outside. It is important to note that it is much easier to make doors opening outwards more watertight than doors which open to the inside ; also, they should be hung as often as possible on *the forward style :* this prevents the inrush of air when the door is open. The passing of the vessel through the air actually sets up a current, which would in itself form a heavy draught were it allowed to enter a room direct ; hence, vestibules and entrance halls are arranged to most large compartments when leading off a deck.

Steering Wheel.—The steering wheel is used for the operating of the rudder, either directly by cables or by control through steam steering gear. There are usually two on the bridge, one on the upper and one on the flying bridge ; also, one or sometimes two are used for an auxiliary steering gear at the after end. They are made all sizes varying from 1 ft. 6 in. to 6 ft. in diameter ; smaller ones are usually of solid metal.

Fig. 193 shows the elevation of the steering wheel ; it has eight spokes inclined at an angle of 45° to one another. It is 3 ft. in diameter, the size being measured over the tips of the spokes. A small *brass cap,* fixed to one of the spokes, is used to indicate some particular position of the rudder ; for example, when the cap is at its highest point the rudder should be in a straight line fore and aft. The *nave* is solid and cast in brass ; it is drilled to fit the shaft connected to the worm gear, and a keyway is cut into it. It is shaped to receive the ends of the spokes, as shown in the sections in Figs. 194 and 195, and the latter are held by screwing through the brass. The spokes are turned to some ornamental shape and the *felloes* are fitted to same.

The felloes are made up of three thicknesses, as shown in section, Fig. 195. The centre pieces are fitted in between the spokes, and the outer ones lap over with break joints, as shown in Fig. 196 ; this assists in binding the whole wheel together. Brass rings, cut out of large plates so as to have no joint, are then sunk into grooves in the felloes ; copper rivets are then put right through the felloes and plates. The spokes are sunk to receive the outer part of the felloe, shown in Fig. 197.

Steering wheels are made from teak and all the joints are put together with lead paint of the same colour. The outer felloe is finished and moulded in a lathe having an open bed to receive the wheel ; it is fitted on to a mandrel the same size as the gear shaft,


— PORTABLE CHART TABLE —
3/8"
1/2"
3"
1 1/8"
2"
2"
ELEVATION
FIG 199
SECTION AA
FIG 200
TAFF — RAIL
3'-0"
PLAN
FIG 201
HALF PLAN
WITH COVER
REMOVED
3'-0"
FIG 202
SECTIONAL ELEVATION
THRO' BRIDGE FRONT
CABIN HOOK
DK.
TENONED AND
WEDGED
CHOCK TO CLEAR
STIFFENERS
4" × 3"
A
A
RULE JOINT
QUADRANT
FIG 203
5/8 GALVANIZED
ROUND BAR
SOCKET
SKETCH SHOWING
SUPPORTS FOR
CHART TABLE
FIG 198
SECTION B.B. SHOWING
COVER OPEN

The wheel is held in position by a nut through which a pin is inserted, and a key prevents it from rotating on the shaft. A brass cover encloses the nut and forms a good finish to the face of the wheel; it is held on by snaphead tap screws.

The drawings shown are dimensioned, and the construction should be easily understood. These wheels are often made by firms who specialise in them and are sent to the ship ready for fitting on to the shaft.

Portable Chart Table.—This chart table is used in fine weather and is fitted in some convenient position on the *navigating bridge;* a sketch is shown in Fig. 198. It is made to suit the size of the charts and is of teak throughout. A glass cover is fitted over the table, in order to keep out water, and the whole table can be dropped down vertically when not in use, thus occupying less room on the bridge. It is hinged to a 4 in. by 3 in. "chock," which is bolted to the steel bridge front, and is supported when in use by a $\frac{5}{8}$-in. galvanised round-iron angle stay.

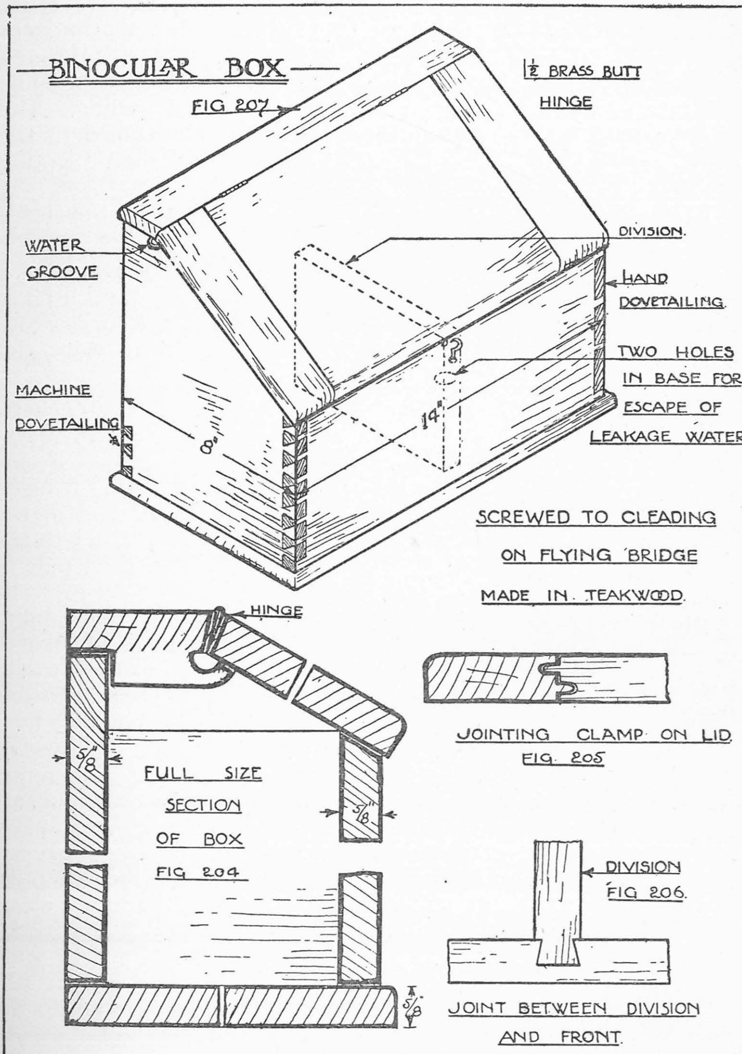
CONSTRUCTION.—The table is made up of a square frame dovetailed at the angles (see sections, Figs. 199 and 200), and has a $\frac{3}{4}$-in. teak tongued-and-grooved base screwed to the frame. The cover is mortised and tenoned together, and screwed from the under side. The glass is fitted into a rebate and bedded in putty; it is held in by sloping heads as shown in section *AA*, Fig. 199. A throating is run on the under side to form a drip for the water, and a feather-and-groove joint is arranged between the frame and cover to keep out the water. The cover is hinged, and is supported by a rule-jointed brass stay, as shown in Fig. 203.

WORKSHOP METHODS.—The frame is dovetailed together, and the water groove cut on the spindle. It is then fitted together and the joint covered with teak paint; a $\frac{3}{8}$-in. pin is inserted from underneath to keep the dovetails from coming apart. The bottom is then screwed on—one board at a time—and the joints are painted. The ends of the boards are rounded.

The cover is mortised together, and the joint is kept a little below the centre; this is necessary on account of the upper surface being sloped. The tenon is haunched and has a long and short shoulder to fit the rebate. It is very necessary that the cover should be made watertight, otherwise the charts would soon become useless from drippings of leakage water.

Binocular Box.—Two binocular boxes, see Fig. 207, are usually fixed to the cleading, or framing, at the front of the flying bridge. They are divided by a vertical division into two parts to hold two pairs of binoculars. The boxes vary greatly in size, but the one shown is quite large enough for what is required. The box is made from teak $\frac{5}{8}$ in. thick. The joints at the corners

are made by what is known as box dovetailing. Machine dove-tailing makes a very strong box, but on account of the ends not



being parallel, and the consequent difficulty of arranging the dovetails on the upper front edge, hand dovetailing is often used;

both machine dovetailing and hand dovetailing are shown in drawing. The bottom is fixed by screwing, and two $\frac{5}{8}$-in. holes are bored through same to allow any leakage water to escape. The lid is hinged to a piece screwed to the back and ends; $1\frac{1}{4}$-in. butt hinges are used. A water groove is worked on the solid piece just under the hinged joint to carry leakage water through the ends seen in section, Fig. 204. The lid is clamped at the ends, and may be jointed as shown in Fig. 205, or by dowelling. The division is simply a rectangular piece housed-dovetailed to the front and back, as shown in plan, Fig. 206. All the projecting pieces have their upper edges slightly rounded.

The boxes are fixed by screwing through the back to the cleading with brass screws.

Telescopic Box.—A box is also often provided outside for a telescope. The only difference between a telescope and a binocular box is that there is no vertical division in the former and the box is longer. The sizes of telescopes are 20 in. to 30 in., and this would be the inside length of the box.

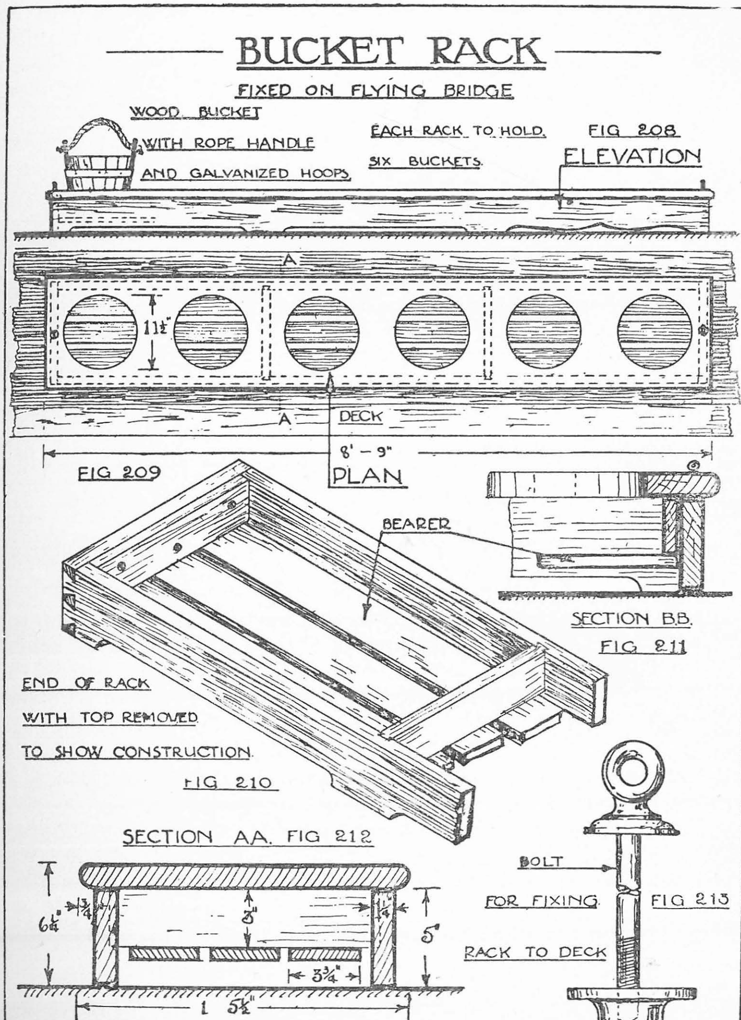
Bucket Rack.—Bucket racks are used for carrying fire buckets, and are placed in different positions in the ship; of late years chemical fire extinguishers have been used in the 'tween decks, and this type of fire bucket is only placed on the flying bridge; two are seen in plan, Fig. 191. A similar rack is used in the 'tween decks where necessary, but instead of being fixed to the deck, as in this case, the rack is usually supported on a pair of gallows brackets attached to a bulkhead.

Bucket racks are made in various lengths to suit the number of buckets required. Some will hold as many as ten buckets; but it is not advisable to make them too long, as they would have to be curved, to suit the sheer or camber of the deck, depending on the position they would occupy. The one shown to hold six buckets is a very common and handy size. The size of bucket is standardised and made by specialists; a common size will fit into a hole of $11\frac{1}{2}$ in. diameter. While the buckets should not be too tight, it is inadvisable to have too much play, as this would allow them to move in the rack, and would result in a greater tendency to throw out the water when the ship rolls.

The given drawings should make the construction quite clear. Figs. 208 and 209 show the plan and elevation. It will be noticed, in elevation, that the sides and ends are hollowed out to some ornamental shape; this allows the water to run underneath, and also forms feet, thus making it easier to fit the rack to the deck.

In plan the main framework is shown by dotted lines. This framework consists of two sides and two ends dovetailed together, and there are two vertical divisions, housed-dovetailed to the sides; these vertical divisions do not extend to the deck, but are

kept up to allow the bearers to be screwed underneath. It will be noticed that the bearers are not fixed directly to the ends but



are screwed to 3-in. by 1-in. grounds attached to the ends. Screws should be used to fix the bearers to the grounds, as the dropping of the buckets into position would easily open the joints

if nails were used. A space is left between each pair of bearers, to allow any water to escape on to the deck, as shown in the sketch, Fig. 210, and the section, Fig. 211. All the joints should be well painted and only brass screws should be used. The top is often made up in two pieces, thus making it easier to cut out the holes for the buckets. It is usually fixed to the deck by settee bolts, as shown in Fig. 213, but in some cases it is lashed by rings and cord or a chain.

In fixing any fittings to a weather deck, as far as possible water should not be allowed to stand in holes in the wooden deck planks; and any fittings, such as brass nuts, as required for ring bolts, should be bedded in lead.

Binnacle Stand.—Binnacle stands are made in various designs and degrees of ornamentation. They vary from a plain wood or iron stand to quite an ornate piece of carved and modelled workmanship. However, the one chosen will embody most of the difficulties met with in ordinary construction. The binnacle, compass, etc., are manufactured by specialists, and all we are really concerned with is the stand. In most cases it is circular on plan and is built up in pieces with coopered joints. The diameter, of course, is governed by the size of binnacle, which is fitted over a rebate at the top of the stand.

The stand shown in Fig. 214 is made up of a bottom octagonal ground; centre ground or shelf of same shape; a built-up circular top; and eight laggings, each of which is jointed and fixed to the grounds.

The grounds are first prepared to the octagonal shape, the setting out of which is shown later. The circular top, which is built up in six pieces, as shown in Fig. 215, is turned in the lathe. The laggings are then fixed to the centre and bottom grounds, and the whole is put into the lathe and turned. The base is then prepared: a solid piece is cut square, and to this the moulding is built up roughly to shape and then finished off in the lathe.

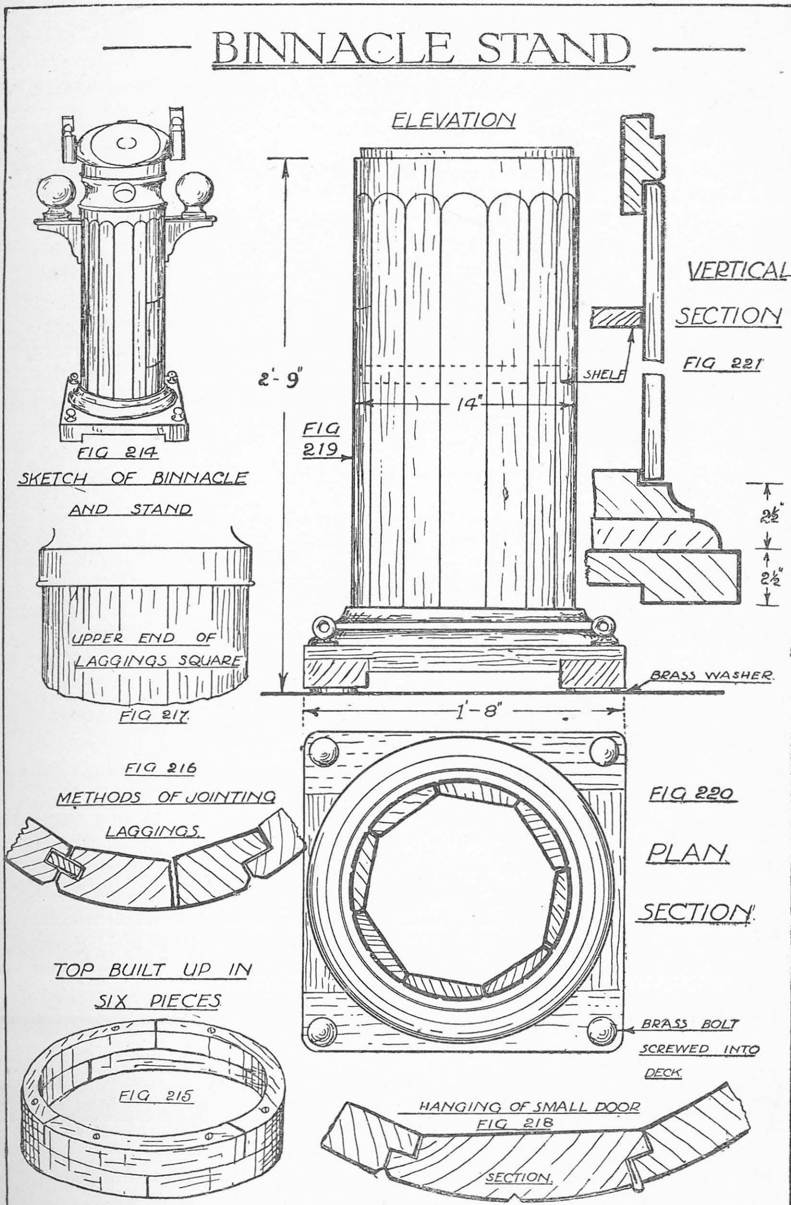
Fig. 216 shows the two methods of jointing the laggings, and Fig. 217 shows an alternate method of finishing the laggings against the circular top; in the latter case they are left square.

Doors are cut into the laggings when complete; these are required to provide access to the electric light and other fittings. They are usually fitted with a lock, and are hung with brass butts; see Fig. 218.

Binnacle stands are held in position by deck bolts of brass, and a thick brass washer is placed between the stand and the deck.

Brackets are screwed to the woodwork to receive the metal correctors seen in sketch, Fig. 214.

These stands are often made of mahogany and are polished, but teak is sometimes used for the base and is stained to the


BINNACLE STAND
ELEVATION
FIG 214
SKETCH OF BINNACLE AND STAND
2'-9"
14"
FIG 219
SHELF
VERTICAL SECTION
FIG 221
2½"
2½"
BRASS WASHER.
UPPER END OF LAGGINGS SQUARE
FIG 217.
1'-8"
FIG 216
METHODS OF JOINTING LAGGINGS.
FIG 220
PLAN. SECTION.
TOP BUILT UP IN SIX PIECES
FIG 215
BRASS BOLT SCREWED INTO DECK
HANGING OF SMALL DOOR
FIG 218
SECTION.

colour of mahogany. V-joints are used between the laggings, and in some cases brass bands encircle the latter to give additional strength and appearance.

Figs. 219 to 221 show the elevation, plan section, and vertical section. The general sizes are all shown on the drawings.

Chart Table.—The chart table is one of the most important fittings in the chart house. It has a broad leaf, which is used for spreading out a chart for examination, and the lower part is arranged for carrying instruments, such as chronometers, sextants, portable sounding machines, etc., with lockers or drawers for the charts. In place of the cupboard space directly below the table on the right-hand side, drawers are very often fitted.

The table itself should be wide enough to give plenty of room for spreading out the charts, and in the example shown it is 3 ft., though the carcase below is only 2 ft. 6 in. wide. At the front edge a groove about $\frac{1}{4}$ in. wide is cut right along, so as to allow the front edge of the chart to be turned in ; this arrangement is better than allowing the charts to hang over the front edge of the table, as they become dirty and are cut by the sharp edge of the table. This cutting of the groove weakens the edge of the table, which is therefore supported by screwing two brass plates about 3 in. wide and 12 in. long underneath the table at each end. A light tray is fixed at the farther edge of the table to hold pen, ink, pencils, measuring instruments, etc. ; this will be seen clearly in plan, Fig. 224, and in sketch, Fig. 228.

Directly underneath the table is a chart locker for holding the charts. This locker is made to project past the carcase front in order to give more space inside, and a flap is hinged at the lower edge and drops down when opened. The flap is made solid and the ends are clamped ; a lock is also supplied to the flap ; this arrangement is shown in section *AA*, Fig. 223, also in sketch, Fig. 226. Underneath the chart locker is a cupboard for additional charts or ship's instruments ; it is fitted with two doors and hinged as shown in elevation, Fig. 222.

On the left-hand side of the table are arranged two lockers with flaps hinged to the chart table, or with *link hinges* which do not project above the surface of the table. The front locker is fitted with a *chronometer box*. This box is designed to suit the manufacturer's sizes of chronometers, and is made with three divisions. The box is lined with green baize and is often padded with horsehair ; in addition to this, pads covered with baize and made to the shape shown in Fig. 229 are used. These pads and padding are necessary to prevent any movement or vibration of the chronometers due to the rolling of the ship. A sketch of the box and its position in the table is shown in Figs. 225 and 229. A glass cover is hinged over the chronometer box, to keep out dust and dirt and to allow a clear view of the chronometers

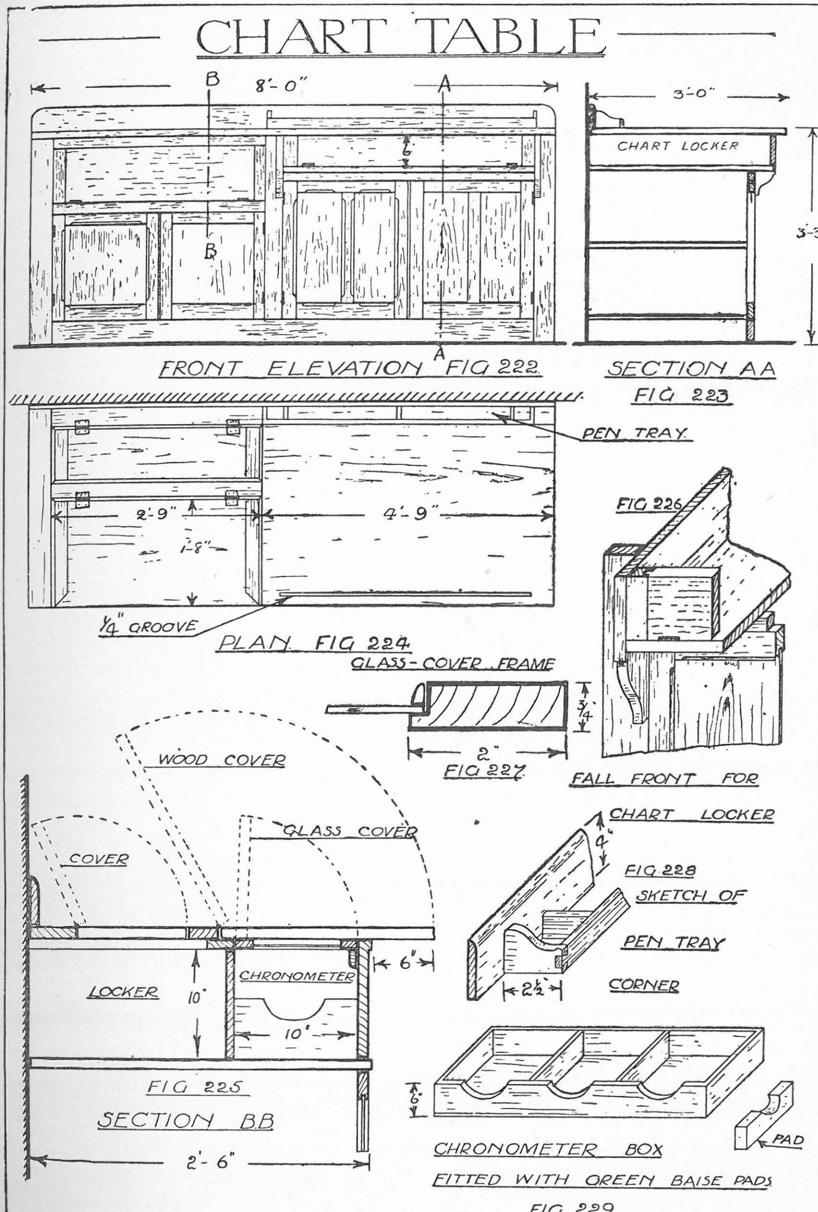


CHART TABLE
B
8'- 0"
A
B
6
A
3'-0"
CHART LOCKER
3'-3"
FRONT ELEVATION FIG 222.
SECTION AA
FIG 223
PEN TRAY
2'-9"
4'-9"
1'-8"
1/4" GROOVE
PLAN. FIG 224.
GLASS-COVER FRAME
3/4"
2"
FIG 227.
FIG 226
FALL FRONT FOR
CHART LOCKER
WOOD COVER
GLASS COVER
COVER
LOCKER
10"
CHRONOMETER
10"
6"
FIG 225
SECTION BB
2'- 6"
4"
FIG 228
SKETCH OF
PEN TRAY
CORNER
2½"
6"
PAD
CHRONOMETER BOX
FITTED WITH GREEN BAISE PADS
FIG 229

when the flap is lifted up. The front of this locker is also hinged in order that the box may be taken out; these details will be seen on reference to section *BB*, Fig. 225.

The cupboards underneath are fitted with a bottom and one middle shelf.

The whole of the table is made in either mahogany or teak and is finished plainly; the doors are chamfered and the whole made to suit the other fittings in the chart house.

Flag Locker.—Fig. 230 shows the sketch of a flag locker. This locker is one of the fittings of a chart or wheel house, and is used for storing flags which are not in use. It is fitted with three shelves, and the upper one has a nest of small pockets to receive pilot flags, which are put in endwise when rolled up. The names of the various flags are usually painted on the front of the holes, thus making it easier to find any required flag quickly. The two lower shelves are used for larger or ensign flags; of course, very large flags can be folded to go inside the locker. These lockers are sometimes left with an open front, but it is safer to have the flags under lock and key; also they are kept cleaner by having doors fitted.

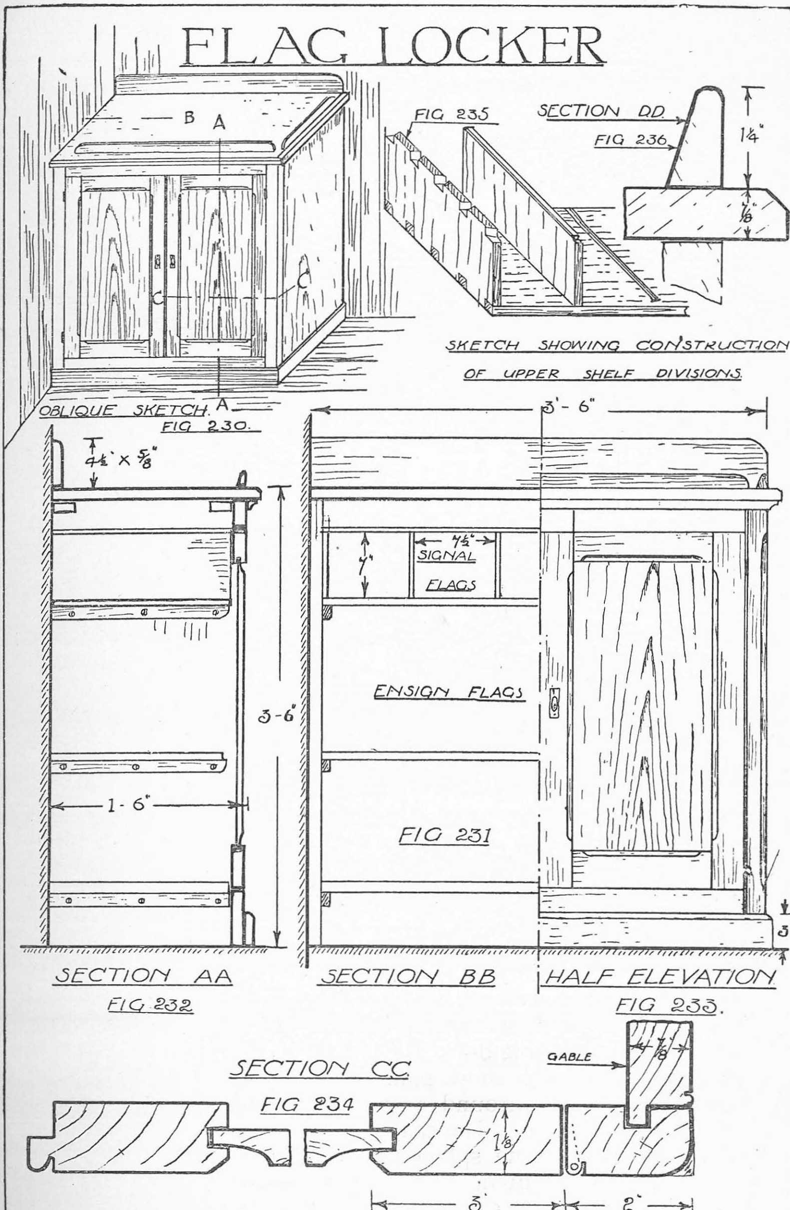
The carcase is made up of a front frame, mortised and tenoned together, along with two solid gables; in the examples shown, one gable would be finished and the other would be set in to allow of the frame and top being scribed against the deck-house side. The shelves are fixed to cleats, or *listings*, which are glued and screwed to the gable seen in sections *AA* and *BB*, Figs. 231 and 232.

The top is chamfered at the edge, and is fitted with a fore-edge on the two open sides, as in section *DD*, Fig. 236; and a piece of skirting 4 in. by $\frac{3}{4}$ in. is screwed to the house side to form a finish to the junction of locker with same. A plinth is fixed to the base, and the external angle of the carcase is rounded, the round being stopped top and bottom. The upper shelf with its nest of lockers is jointed together, as shown in Fig. 235. The angles are dovetailed and the vertical divisions housed-dovetailed together.

Section *CC*, Fig. 234, shows the joint between the gable and front frame, which should be pocket screwed from the inside, and also a section of the door, the stiles of which are stop chamfered; the joint between the two meeting stiles is rebated.

The metal fittings include lock, knob and spring latch, hook and eye to hold the left-hand door, and two pairs of $2\frac{1}{2}$-in. brass butt hinges.

Joints in Guard Rails.—A guard rail is the uppermost of a series of rails around any open deck, and its purpose is to prevent persons from falling overboard. The BOARD OF TRADE issue


FLAG LOCKER
B
A
C
FIG 235
SECTION DD.
FIG 236
1¼"
⅞"
SKETCH SHOWING CONSTRUCTION
OF UPPER SHELF DIVISIONS.
OBLIQUE SKETCH.
FIG 230.
4½" × ⅝"
3'- 6"
4½"
7"
SIGNAL
FLAGS
ENSIGN FLAGS
3-6"
1- 6"
FIG 231
3"
SECTION AA
FIG 232
SECTION BB
HALF ELEVATION
FIG 233.
SECTION CC
FIG 234
GABLE
⅞"
1⅛"
3"
2"

regulations relating to same, but the only one of importance refers to the height " *which should be not less than* 3 *feet* 6 *inches* " from the deck.

The upper rail is usually a stout piece of wood for passengers to lean on when looking out to sea. It is called by various names, some of which are *guard rail, taff rail,* and *accommodation rail.*

Figs. 238 and 239 show a method of *scarfing,* or lengthening, a wood rail over a stanchion. The length of scarf should be at least one and a half times the width of the rail, and to prevent any sharp points the ends of the scarf are butted. The bolts have flat heads and are sunk into the rail a depth of $\frac{1}{2}$ in. The under side of the heads are coated with lead paint and oakum, and the hole is made good by a dowel driven in tight and coated with paint.

Figs. 240 and 241 show the joint where the ends of two rails meet in a right angle. The joint is halved and mitred, the halving being stopped so as not to be seen on the edges of the rail ; a sketch of one piece when taken apart is shown and should make the construction clear.

Figs. 242 and 243 show the joint where two rails intersect at right angles. The rounded portion is mitred and the flat part is halved. A sketch of one piece is shown, and the joint is held together by screwing.

Figs. 244 and 245 illustrate the jointing of a round corner. A separate piece is jointed on to the required radius. The joints are halved and screwed, and the moulded portion is butted. It will be noticed that the joints are not on the springing of the curve, but are carried a distance of 2 in. beyond the springing. The reason for this is that it is much easier to make the joint with the abutting pieces in a straight line.

Figs. 246 and 247 illustrate the method of finishing a bridge front in wood. In order to make the bridge front strong, and to provide a means of supporting the guard rail, steel stanchions are riveted to the *curtain plate,* and carried up to the guard rail to which they are bolted and screwed. A coaming is fitted around the stanchions, scribed to the deck, and bolted to the curtain plate. The sheeting is nailed to the coaming and to a listing screwed up to the guard rail, while a small scotia mould covers the joint between the rail and sheeting. The guard rail should be throated on the under side to throw off the water and prevent it running down the sheeting.

Figs. 248 and 249 show plan and elevation of a method of fitting a guard rail around a steel stanchion, which is carried up to the deck above. The rail is cut to fit against the stanchion and at the same time splayed to receive a scarf piece. This piece is fitted, painted, and then screwed in position. The rail is supported by two iron lugs as shown in elevation.

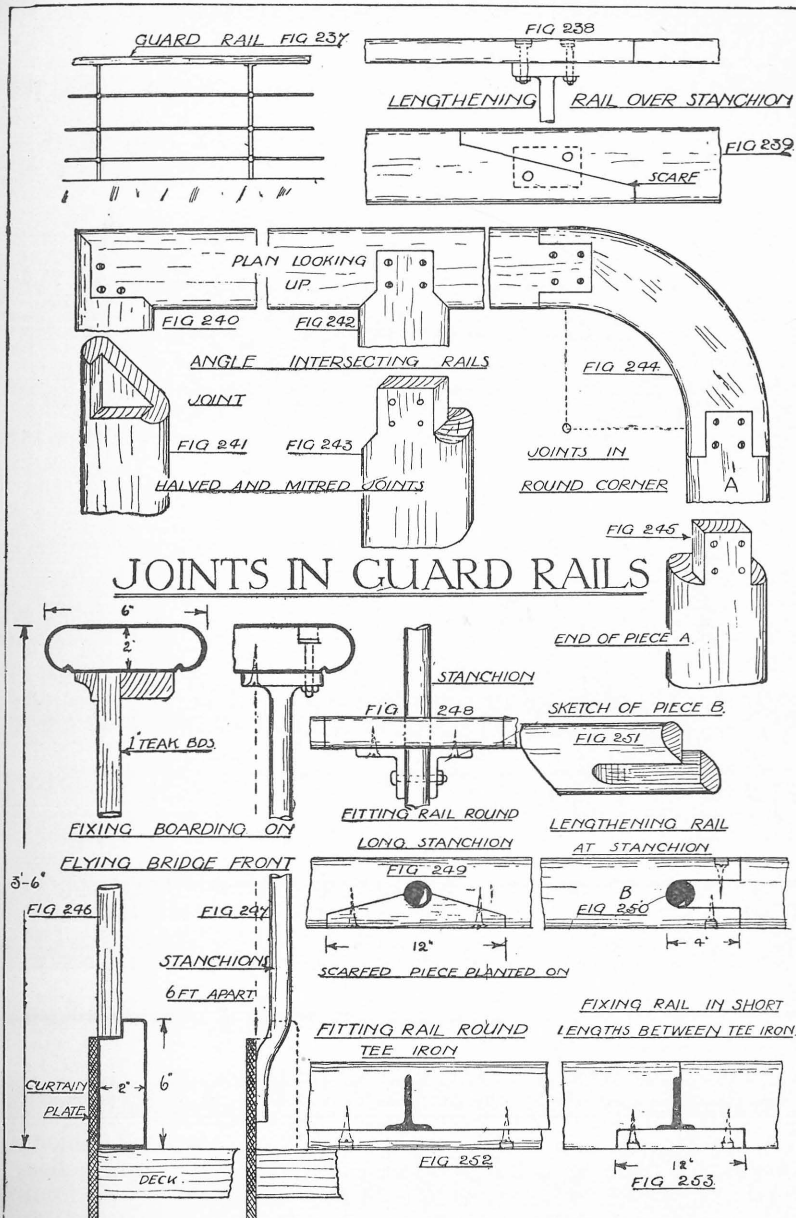

GUARD RAIL FIG 237
FIG 238
LENGTHENING RAIL OVER STANCHION
FIG 239
SCARF
PLAN LOOKING UP
FIG 240
FIG 242
ANGLE INTERSECTING RAILS
JOINT
FIG 241
FIG 243
HALVED AND MITRED JOINTS
FIG 244
JOINTS IN ROUND CORNER
A
FIG 245
JOINTS IN GUARD RAILS
6"
2"
1" TEAK BDS
FIXING BOARDING ON FLYING BRIDGE FRONT
3'-6"
FIG 246
FIG 247
STANCHIONS 6 FT APART
CURTAIN PLATE
2"
6"
DECK
STANCHION
FIG 248
FITTING RAIL ROUND LONG STANCHION
END OF PIECE A
SKETCH OF PIECE B
FIG 251
LENGTHENING RAIL AT STANCHION
FIG 249
12"
SCARFED PIECE PLANTED ON
B
FIG 250
4"
FITTING RAIL ROUND TEE IRON
FIG 252
FIXING RAIL IN SHORT LENGTHS BETWEEN TEE IRON
12"
FIG 253

Fig. 250 shows a method of lengthening a guard rail around a stanchion. It is formed by a *bridle joint,* as seen in Fig. 251; only a portion is cut away so as to fit against the stanchion.

Fig. 252 shows a method of fitting a guard rail around a T iron stanchion when the latter is continued up to the deck above. The projecting portion beyond the T is ripped off with the saw, and is fitted and screwed on to the rail again when the latter is in position.

Fig. 253 shows a method of fitting short lengths of guard rail between each pair of T iron stanchions.

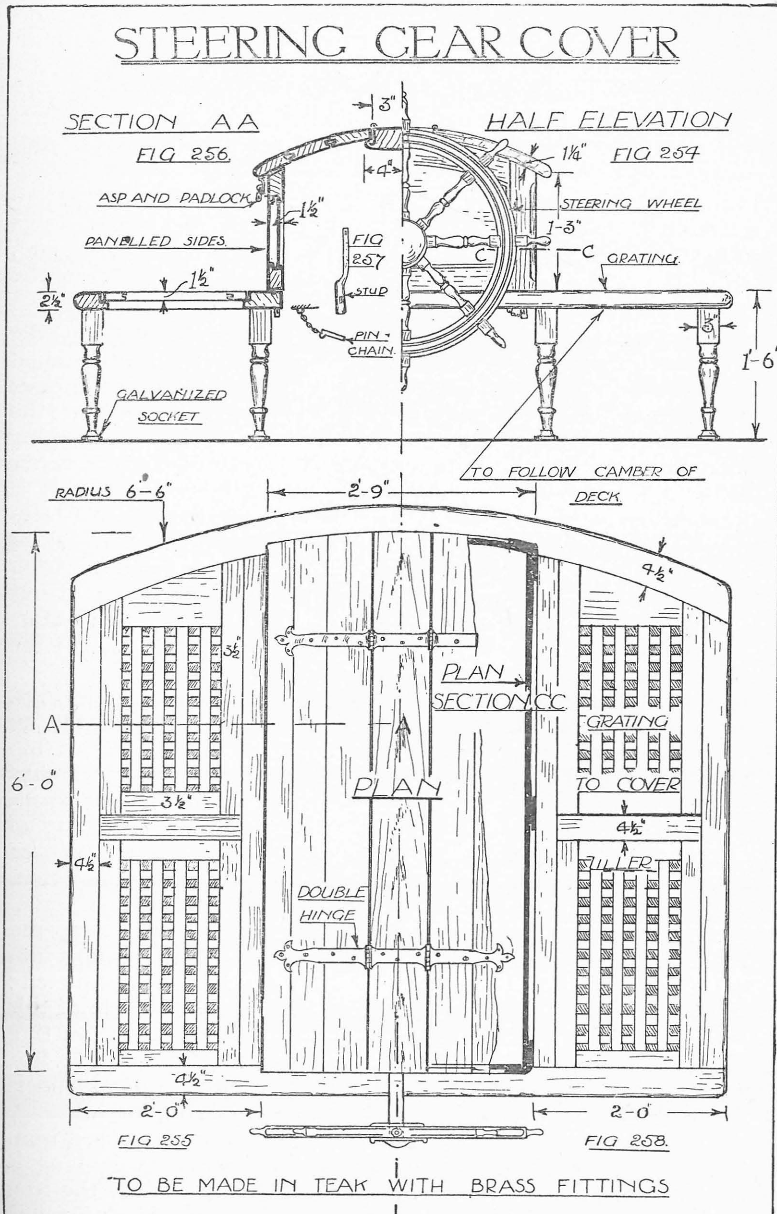
Steering Gear Cover.—In many ships an *auxiliary steering gear* is provided in case of any accident to the steam steering machinery. This gear is worked by hand, and one, or sometimes two, wheels are fitted for this purpose. It can be coupled to the tiller when required.

This gearing, which is largely of steel and brass, requires some protection from the weather, and therefore a wooden cover is usually provided. By a combination arrangement the platform which supports the gear cover also forms a protection for the tiller which works underneath.

The **grating** is supported on turned legs, as shown in elevation, Fig. 254, and is made up of a main framework, with lighter framings made up into grating; this will be clearly seen in plan, Fig. 255. The legs are held to the deck by brass or galvanised iron sockets, and in some cases through bolts are inserted and the deck is tapped to receive same. The edges and corners of the framework are all rounded, and the grating is constructed so as to be portable. The construction of the grating is fully illustrated in Figs. 264, 265, which show the leadsman's platform. The light-framed gratings can be made flat, but the heavier framework should follow the camber of the deck.

The cover itself is made up of four sides, framed and jointed at the angles with an ovolo and tongue joint; see Fig. 258. The framing should be strong, say $1\frac{1}{2}$ in. thick, and extra support at the angles might be obtained by screwing brass plates on the inside. Mouldings are often planted around the panels. The ridge or crown piece is made very similar to the ones for skylights.

Water grooves are worked at the joints between the hinged covers and the ridge, and carry the water out to each end. The hinged flaps are built up to the required curve, as shown in section *AA*, Fig. 256, with *coopered* joints. Ledges are screwed on the under side to strengthen the flaps. In some cases, the flaps are not curved but made straight, in the ordinary saddle-back fashion. Large double strap hinges are used, as shown in plan, and a *hasp* and *padlock* are fitted to each flap to prevent anyone from tampering with the gear.


STEERING GEAR COVER
SECTION AA
FIG 256.
HALF ELEVATION
FIG 254
3"
4"
1¼"
ASP AND PADLOCK
1½"
STEERING WHEEL
PANELLED SIDES.
1-3"
FIG 257
C
C
GRATING.
1½"
2½"
STUD
PIN-CHAIN.
3"
1'-6"
GALVANIZED SOCKET
TO FOLLOW CAMBER OF DECK.
RADIUS 6'-6"
2'-9"
4½"
3½"
PLAN SECTION CC
A
A
GRATING TO COVER
PLAN
6'-0"
3½"
4½"
4½"
TILLER
DOUBLE HINGE
4½"
2'-0"
2'-0"
FIG 255
FIG 258.
TO BE MADE IN TEAK WITH BRASS FITTINGS

The whole cover is held down to the grating by studs and pins, as shown in Fig. 257. The pins are attached to a chain which is fastened to the grating. The stud is screwed to the cover on the inside and holes are bored through the grating to receive same. This arrangement makes the whole cover portable, and the flaps provide access to the gear for cleaning and oiling.

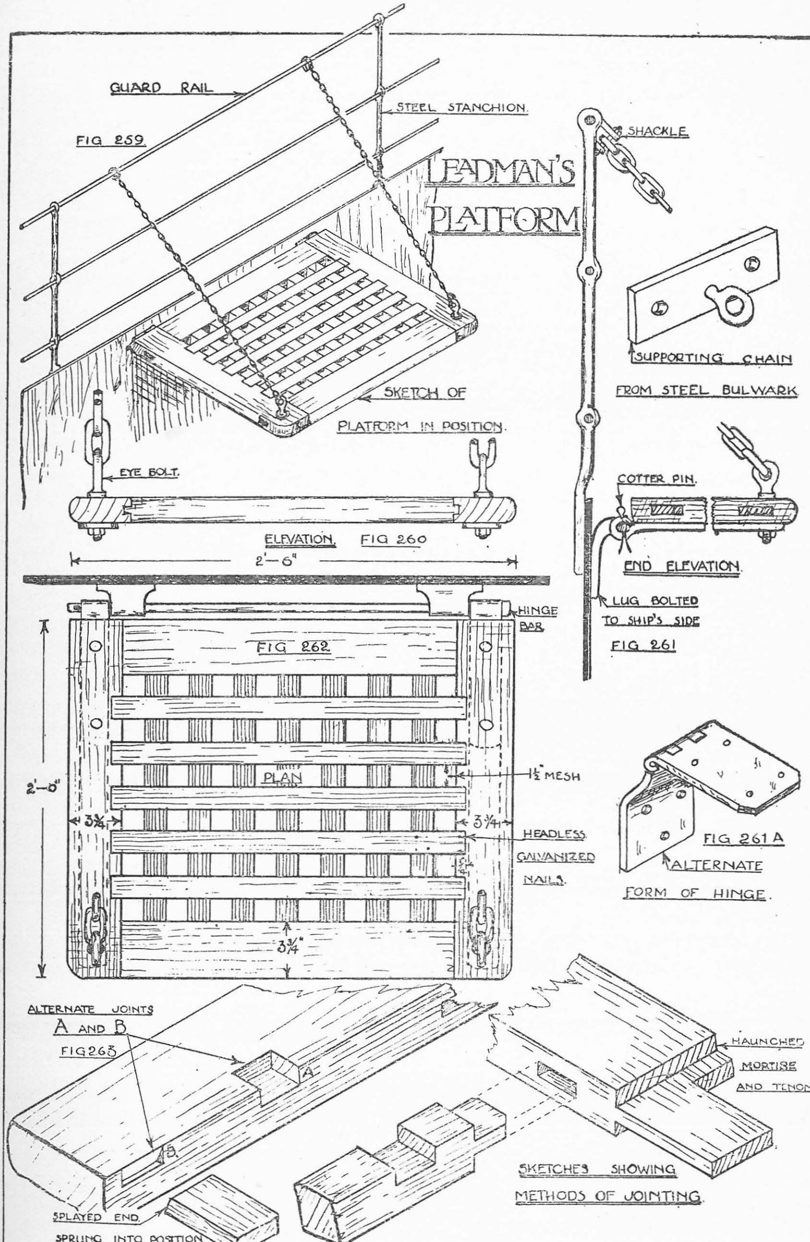
The construction of the steering wheel is shown in a separate drawing on page 47. The cover is made in teak, and brass fittings are chiefly employed. It is situated right at the after end, and the curve at the back of the grating is made to follow the shape of the ship's stern.

The Leadsman's Platform.—These platforms are used by the leadsman when taking soundings. The platform is suspended over the side of the boat to give a firm footing and, of course, in addition to this, a wide canvas belt is used to support the leadsman in his difficult duties. Sounding machines are coming more into use; but when the ship is plying in shallow water soundings have to be taken more frequently and the lead is lowered by hand. It will at once be evident that this platform must be secure and should be well constructed. In some ships two are placed adjacent to the bridge, so that the navigating officer may be able to hear the various soundings shouted out by the leadsman; one is on the port side and one on the starboard side. Of course, in larger ships two additional ones are placed near the docking bridge.

Fig. 259 shows a sketch of a suitable platform; while Figs. 260 to 262 show its plan and two elevations. It is framed up with two stiles and two rails; the stiles are placed athwartship and the rails fore and aft. They are made of teak and are $3\frac{3}{4}$ in. by 2 in., and mortised and tenoned together. The space between is filled in with grating. The grating is made up of 2 in. by $1\frac{1}{2}$ in. bars mortised to the rails: these bars are *raggled* to receive the $1\frac{1}{2}$ in. by $\frac{1}{2}$ in. pieces in a fore-and-aft direction, and the stiles are notched to receive these pieces.

An alternative method of fixing these pieces is to cut a tapered notch into the stiles, and they are then raised and sprung into position after the other parts of the platform are completed; this arrangement is shown in Fig. 263 at *B*. The whole of this framework is jointed and all the joints well painted before putting together. The grating is nailed together by *headless nails*, which are of galvanised iron. It is formed into squares and is denoted by the size of square, as $1\frac{1}{2}$ in. mesh or 2 in. mesh.

The ironwork fittings, which are usually all of galvanised iron, form an important feature of the construction. Everything is arranged so that the platform can be lifted up against the iron railing when not in use. It is hinged to the ship's side by means


GUARD RAIL
STEEL STANCHION.
FIG 259.
LEADMAN'S PLATFORM
SHACKLE
SKETCH OF PLATFORM IN POSITION.
SUPPORTING CHAIN FROM STEEL BULWARK
EYE BOLT.
ELEVATION. FIG 260
2'—6"
COTTER PIN.
END ELEVATION.
LUG BOLTED TO SHIP'S SIDE
FIG 261
HINGE BAR
FIG 262
PLAN
2'—0"
1½" MESH
3¾
3¾
HEADLESS GALVANIZED NAILS.
3¾"
FIG 261 A
ALTERNATE FORM OF HINGE.
ALTERNATE JOINTS A AND B
FIG 263
A
B
HAUNCHED MORTISE AND TENON
SKETCHES SHOWING METHODS OF JOINTING.
SPLAYED END SPRUNG INTO POSITION.

of a pair of hinges working on a bar. The hinges are carried right across the platform, and the eye bolt to which the supporting chain is attached goes through the hinge. The hinge bar is supported by lugs, which are riveted to the ship's side, as seen in elevation, Fig. 261. An alternative form of hinge sometimes adopted is shown in Fig. 261, *A*, but it is not so good as the form previously described.

The outer edge of the platform is supported by a chain, with an eye bolt through the platform and a shackle over the top steel rail; but in cases where a steel bulwark is carried up, a plate to which an eye bolt is attached is riveted through the bulwark, as shown in Fig. 261.

In some cases the platform is constructed and supported by a collapsible crutch in a manner very similar to the upper platform of an accommodation ladder.

CHAPTER VI

CAPTAIN'S QUARTERS

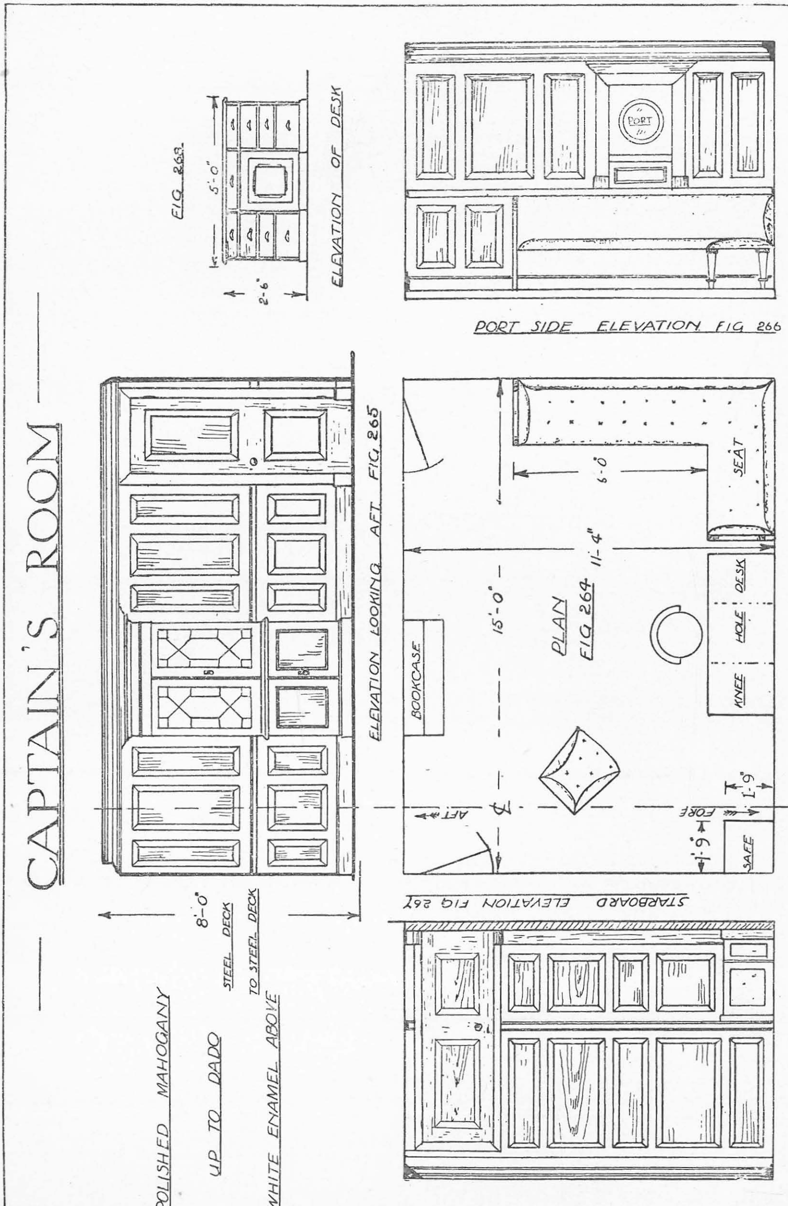
SITUATION and Arrangement.—The Captain's quarters are usually situated on the upper or the flying bridge. In some cases, they consist of a combined *state-room* and *day-room*, but in large vessels separate rooms are provided and the day-room is used as an office. The accompanying drawings illustrate the latter arrangement, and a Captain's state-room is shown in Fig. 192. Fig. 264 gives the plan of the day-room and the arrangement of the different furnishings. There are two doors, one as an entrance from a passage and one leading to the state-room ; in many cases only a curtain is fitted between the day-room and state-room. In addition to the furnishings shown, a table is often provided, so that if necessary the Captain may dine in his own room.

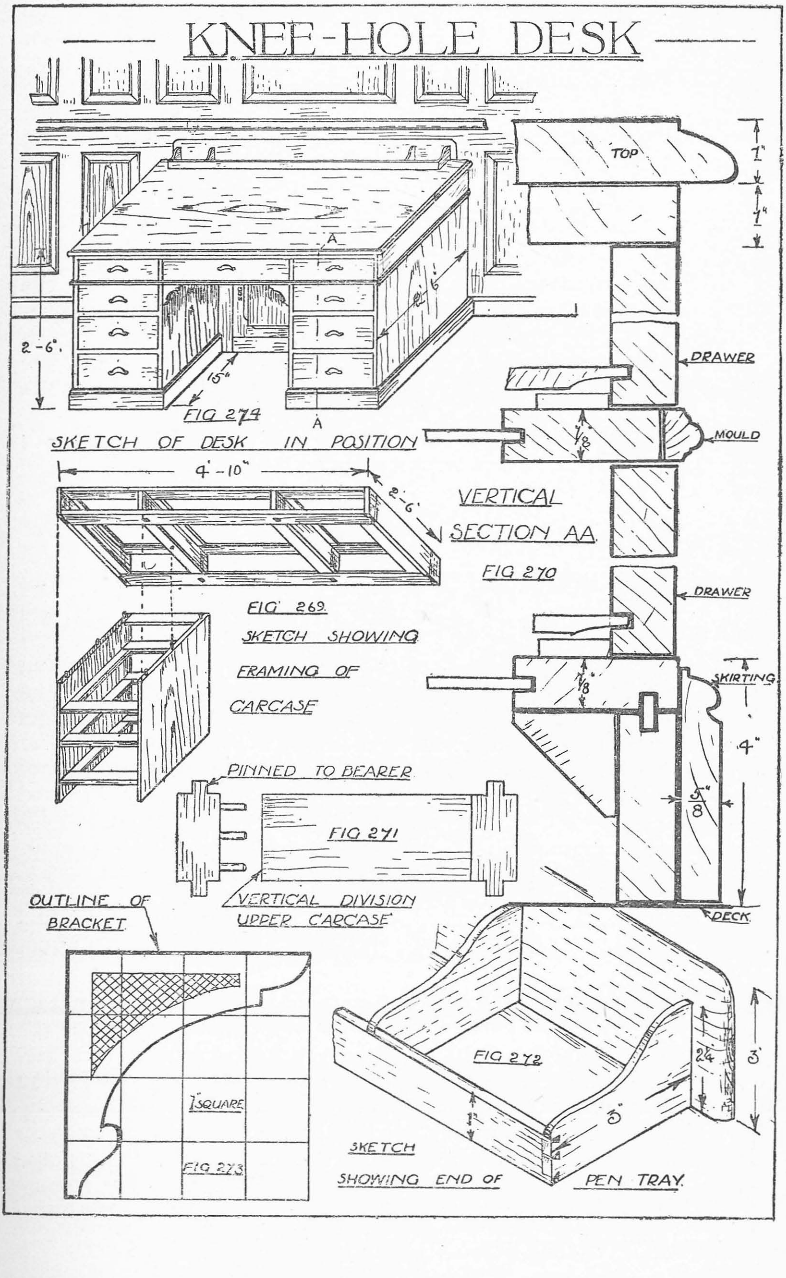
A *bookcase* is fitted and is seen in elevation, looking aft, in Fig. 265. The lower part is in the form of a cupboard, and the upper part is fitted with glass doors and shelves ; in some cases two drawers are fitted between the lower and upper cupboards. Alternative methods of dealing with the framing behind the bookcase are : (*a*) to make the framing serve the purpose of back to the bookcase by fitting in flush panels ; (*b*) to leave out the framing entirely and to fit a back to the bookcase ; and (*c*) to continue the framing through, finished in the ordinary way, and to fit a back to the bookcase as well. This latter arrangement allows of the bookcase being moved to any position, if so required at a later date, without any structural alterations in the framing.

These considerations apply to all furniture which is carried up from one deck to the other. In any case, it will be understood that the framing *must be designed to suit the size and position of the furnishings* to be placed against it ; and in order to give the reader an idea of such general arrangement the whole elevation of furniture and framing is shown.

The *knee-hole*, or *pedestal, desk* is fitted on the forward side, and should be arranged to have a window opposite. A revolving *chair* is also supplied. An elevation of the desk is shown in Fig. 268, and full details are given in Figs. 269 to 274. An easy-chair is also supplied with movable attachment to deck.

A safe for the ship's papers is fitted in one corner and is often raised on a wood base from the deck, as seen in starboard elevation, Fig. 267 ; a seat in the angle between the forward and port sides completes the main furnishings.


CAPTAIN'S ROOM
POLISHED MAHOGANY
UP TO DADO
STEEL DECK
TO STEEL DECK
WHITE ENAMEL ABOVE
8'-0"
ELEVATION LOOKING AFT FIG. 265
FIG. 268
5'-0"
2'-6"
ELEVATION OF DESK
PORT
PORT SIDE ELEVATION FIG. 266
SEAT
6'-0"
11'-4"
15'-0"
PLAN FIG. 264
KNEE HOLE DESK
BOOKCASE
AFT
FORE
1'-9"
SAFE
STARBOARD ELEVATION FIG. 267


KNEE-HOLE DESK
TOP
1"
1"
DRAWER
MOULD
7/8
2-6"
15"
6"
A
A
FIG 274
SKETCH OF DESK IN POSITION
4'-10"
2'-6"
VERTICAL
SECTION AA
FIG 270
FIG 269
SKETCH SHOWING
FRAMING OF
CARCASE
DRAWER
SKIRTING
7/8
4"
5/8
DECK
PINNED TO BEARER
FIG 271
VERTICAL DIVISION
UPPER CARCASE
OUTLINE OF
BRACKET
1" SQUARE
FIG 273
FIG 272
2¼
3"
3"
1"
SKETCH
SHOWING END OF
PEN TRAY

The various elevations shown will give a general idea of the way the framing is treated around the furnishings and openings, and how the panels are arranged; in the port side elevation, Fig. 266, the treatment around a side-light is shown, with the alternating sizes of panels. In the starboard elevation is seen the wide and narrow panel repeat, with the treatment around a door, including *architrave, plinth blocks* and *cornice*. Once the plan of the room is decided, it is very important that the framing and repeat panelling should be nicely arranged to give a pleasing effect.

Knee-hole Writing Desk.—This type of desk is part of the furnishing of the Captain's day-room, or office. The height is usually 2 ft. 6 in. and the length about 5 ft. over all. It is composed of three carcases, two pedestals and a top carcase. The pedestal carcases are each fitted with three drawers, and the top carcase is also fitted with three drawers.

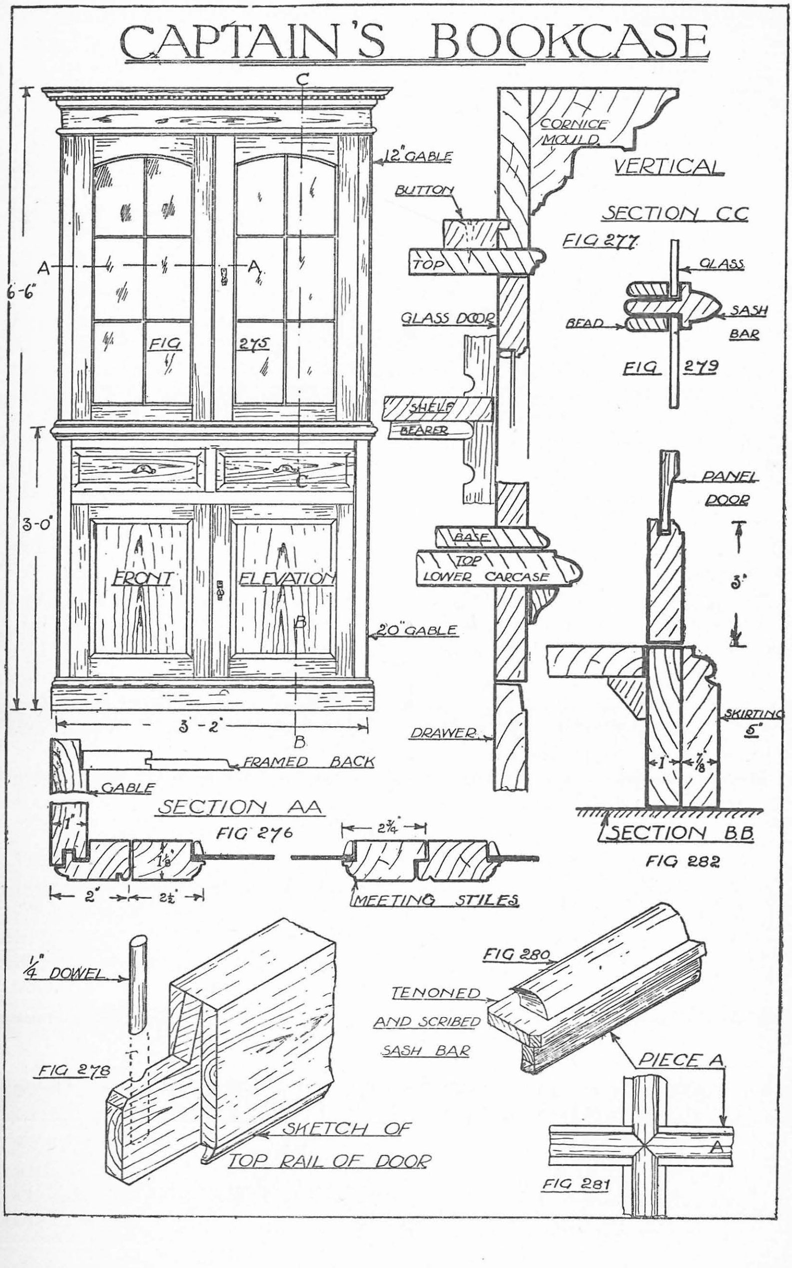
A *small cupboard* is arranged between these two carcases: the gables of the latter forming its two sides; the framing, its back, and a front frame with door are fitted 15 in. from the front edge of the gable. A pen tray is placed on the top of the desk, and is shown in sketch, Fig. 274.

The **lower carcases** are made up of two solid gables, and should one end come against the bulkhead or another piece of furniture a *mock gable* and fitting stile will be required. The front bearers are arranged to suit the size of drawers which are—reading from the top drawer—4 in., 5 in., 6 in., and 7 in. deep. The bearers are housed-dovetailed into the gables, and drawer runners are screwed to same and mortised into the bearers. No bearer is provided at the top of pedestal carcase as the bearer and runner of upper carcase serve the purpose. Dust boards are grooved into bearers and runners, and a plinth is screwed from the inside of the carcase, the corners being lapped and rounded or mitred.

Fig. 269 illustrates the **top carcase**, which is composed of two short gables with the grain being a continuation of the grain in the gable below. The joint between the two is hidden by a planting mould, as shown in Fig. 270. The centre vertical divisions are clamped and tenoned to bearers, as shown in Fig. 271, the front clamp being of the same wood as the front of the desk. The top is usually finished by polishing, but is sometimes clamped and fitted with leather; it is fixed by slot screwing from underneath.

Two brackets, fitted between the two carcases, as shown in Fig. 273, give a finished appearance to the knee-hole. The shape of the bracket has been shown in inch squares, which is a very useful method of copying curves.

CAPTAIN'S BOOKCASE



The *pen tray* is made of $\frac{1}{4}$-in. mahogany and framed up, as shown in Fig. 272.

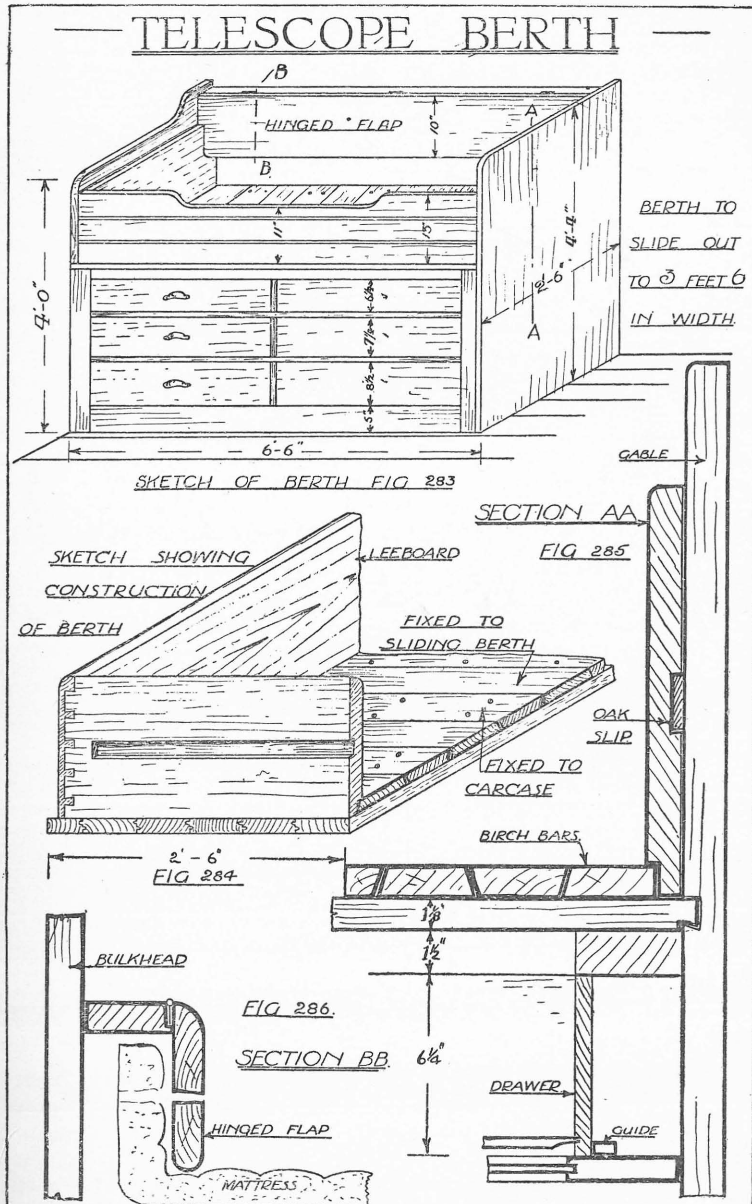
The pedestal and top carcases are made portable, and are firmly fixed when in position by dowels and screwing.

Captain's Bookcase.—The bookcase shown is made up in two carcases, the lower one including cupboard for large volumes and two drawers, the upper one with glass doors and portable shelves. The upper one includes the cornice, which is fixed by buttoning from the inside. The general arrangement is shown in elevation, Fig. 275.

The **lower carcase** is framed up with two solid gables, a framed back, and a front frame. The front frame is universally adopted on account of it being required to scribe to bulkheads, etc.; and although not required in that capacity in this particular case, it is used in order to have a similar appearance to other furnishings. The joint between the front frame and the gables is shown at section *AA*, Fig. 276, and is rebated, grooved, and moulded; the gables are rebated to receive the back. This jointing is similar in both carcases.

The doors, which are mortised and tenoned together, are hinged on the outer stiles and are rebated at the meeting stiles. There are no shelves in the lower cupboard, the books or atlases being placed vertically. The two drawers are dovetailed together and the fronts are rebated and sloped off to imitate the raised panels in the doors below. The top is fixed by screwing from underneath; it is moulded with a thumb mould, and a small ogee is planted on underneath to give it a heavier appearance. A moulded skirting is planted around the base and is often of the same design as the skirting planted all round the room and with which it intersects.

The **upper carcase** is made up of gables 11 in. wide, to which the top and bottom are dovetailed and to which two hanging stiles are fixed. The back is framed up, and section *AA*, Fig. 276, shows the jointing between the gables and the hanging stiles. It is fitted with three shelves, making four divisions, and giving an average height of $8\frac{1}{2}$ in. between each shelf. These shelves are, however, made portable and can be moved up or down to suit the size of the books. The arrangement for raising or lowering the shelves is shown in section *CC*, Fig. 277; a horizontal *bearer* is fitted between two upright pieces, these pieces having semicircular holes cut in their inner edges to receive the rounded ends of the bearers. The bearer is simply held in position by the weight of the shelf. In preparing the vertical pieces, each pair is made out of one piece, which is bored at suitable intervals and then *ripped* down the middle


TELESCOPE BERTH
B
HINGED FLAP
10"
B
A
BERTH TO
SLIDE OUT
TO 3 FEET 6
IN WIDTH.
11"
15"
4'-4"
2'-6"
4'-0"
6¾
7½
8½
5
A
6'-6"
GABLE
SKETCH OF BERTH FIG 283
SECTION AA
FIG 285
SKETCH SHOWING
CONSTRUCTION
OF BERTH
LEEBOARD
FIXED TO
SLIDING BERTH
OAK
SLIP
FIXED TO
CARCASE
BIRCH BARS
2' - 6"
FIG 284
1⅛"
1½"
BULKHEAD
FIG 286.
SECTION BB.
6¼"
DRAWER
HINGED FLAP
GUIDE
MATTRESS

at the saw; they are then planed up and fixed to the gables by glue and brads.

The **glass doors** are made in various designs. those shown being very simple with straight bars and curved top rail. The jointing of the rails to the stiles is shown in Fig. 278. In joints of this kind, where the tenons should not go right through the stiles, and where some additional strength is required besides the glue, a very good method is the one shown. The door is glued together, and whilst in the cramps a hole is bored in the end of the stile so as to cut a small portion away from the tenon, and then a dowel is glued and driven in; the end of the dowel if of the same wood as the door is scarcely discernible and the joint is quite strong. The same joint would be employed in framing the doors below. The section of the sash bar is shown enlarged in Fig. 279; it is made to mitre in with the ovolo on the door frame, and is rebated to receive the glass, which is held in by *beads*. The jointing of the bars present some little difficulty and require care to make a good joint. The horizontal ones run right through and the vertical ones are tenoned to same. The joint is shown in Figs. 280 and 281, and it will be noticed that the ovolo is scribed and the rounded portion underneath is mitred. The tenon, of course, only goes half way through.

The **cornice** is built up separately and fixed to the top by *buttons*, as shown in section *C C*, Fig. 277. A section of the cornice mould is also shown in same figure. The cornice is *secret dovetailed* together at the angles and the moulding is mitred, glued, and screwed from the inside.

A detail showing section *B B* through base of lower carcase and plinth is shown in Fig. 282.

Telescopic Berth.—This type of berth is fitted in the Captain's room, and may be used as a single or double bed. It is also often seen where state-rooms are used by families. When closed up it is in many respects similar to the bed and drawers described in Chapter XII; the chief difference is in the berth, which can be pulled out like a drawer. When closed its width is 2 ft. 6 in., and when open it is 3 ft. 6 in. to 4 ft.

The lower part requires little or no explanation, except that the finished gable on the right-hand end laps over the front frame, and a mock gable is put into the opposite end which fits against a bulkhead; see Fig. 283.

The **sliding berth** is made like a large drawer without a back; part of it is shown in Fig. 284. The top of the drawer carcase is covered by jointed 1-in. boards, and on these the berth slides. The *slide bars* are made dovetailed shape, and alternate ones are fixed to the top of carcase and to the berth. The berth sides are made 1 in. thick and are grooved to receive a hardwood

slip which is screwed to the gable, seen in vertical section *AA*, Fig. 285. The mattress, which is of the same width as the berth when open, namely 3 ft. 6 in., is stowed under a hinged flap at the back when contracted to the single berth width of 2 ft. 6 in.; see section *BB*, Fig. 286. The *leeboard*, or front of berth, is hollowed out in the centre, as seen in Fig. 283.

The sides of the berth and the dovetailed slides are made in birch on account of its hard wearing qualities; and all the exposed parts are made in mahogany or of the same wood as the other fittings in the room.

CHAPTER VII

SKYLIGHTS AND WINDOWS

VARIETIES of Skylights.—Skylights are used as a means of lighting the 'tween-deck spaces, and to afford an extra means of ventilation. In many cases, however, they cannot be depended upon to act in the latter capacity as they must be kept closed in stormy weather. Also, the sashes in some cases are fixed, the ventilation being provided either by mechanical means, or by *mushroom ventilators* with shafts taken from the upper decks.

The various forms of skylights met with in ship joinery are:

Flat skylights, where the rolling of the ship throws off the water.

Ordinary pitched skylights, having two pitches like a roof. The pitch is usually about 1 in 2.

Dwarf skylights, used in alleyways to transmit light to the deck below.

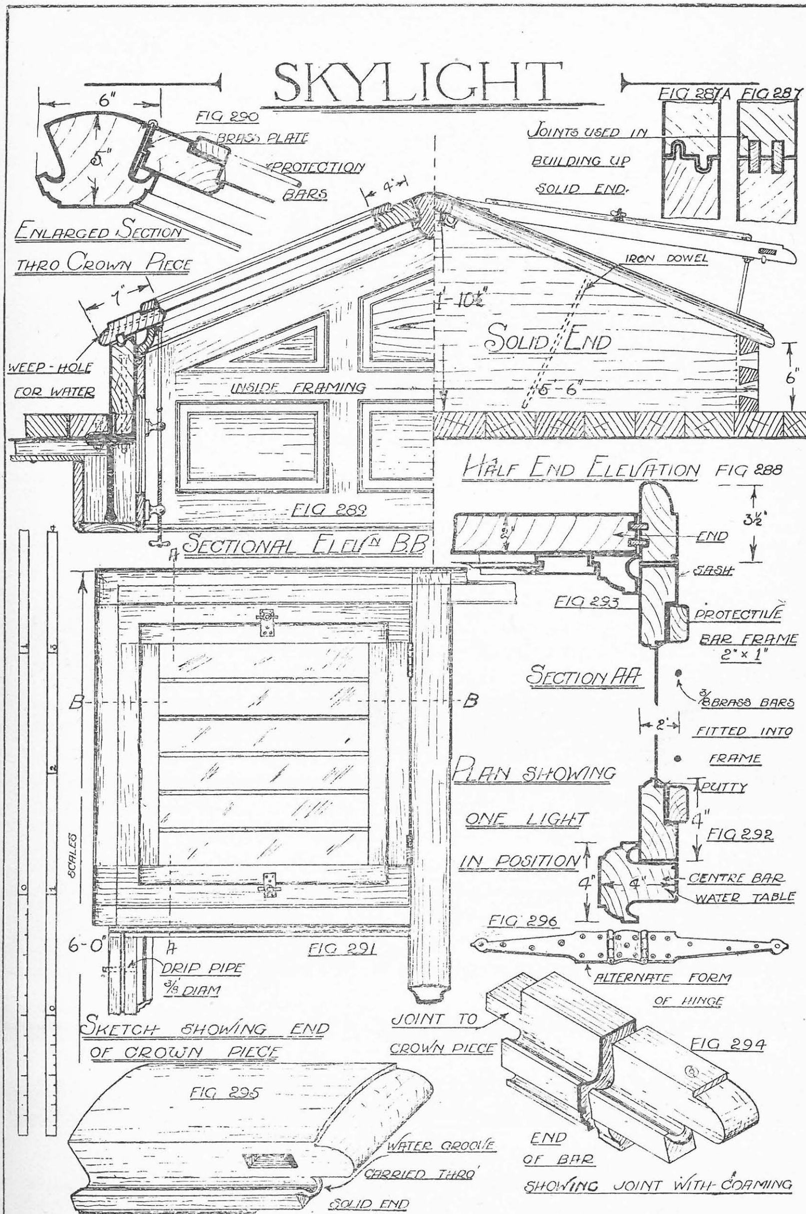
Circular-headed skylights, used mostly over small saloons; the ends are vertical and the upper part semicircular.

Elliptical dome skylights; and

Deck lights; prismatic lights; etc.

It is very essential that *watertightness* should be ensured in the construction of skylights, and that provision should be made for leakage and condensation moisture. These points will be fully dealt with in the illustrations and working drawings. Also, on weather decks, where there is any likelihood of wash coming aboard, a tarpaulin is arranged to cover the whole skylight; it is held in position by a wrought-iron strap wedged into slotted pieces which are bolted to the coamings.

Ordinary Pitched Skylight.—This skylight is made up of a heavy coaming, securely fixed to the deck, and which supports the sashes. The fore-and-aft coaming is dovetailed to the solid ends, as in the jointing of coamings for deck-houses. The ends often require to be jointed and, if so, a *double tongue* is inserted, as shown in Fig. 287, and two $\frac{5}{8}$-in. round iron dowels are put in at an angle to keep the ends straight and to prevent the joints coming apart; these dowels are shown dotted in end elevation, Fig. 288. The coamings are securely fixed to the deck by bolts. Angle irons are riveted around the opening, and the deck planks are caulked up against them. The skylight is framed to this size, and the lower part of the coamings are rebated to fit over this angle iron; see section, Fig. 289. The fore-and-aft coamings


SKYLIGHT
6"
5"
FIG 290
BRASS PLATE
PROTECTION
BARS
4"
ENLARGED SECTION
THRO CROWN PIECE
FIG 287A FIG 287
JOINTS USED IN
BUILDING UP
SOLID END.
IRON DOWEL
7"
1'-10½"
SOLID END
WEEP-HOLE
FOR WATER
INSIDE FRAMING
5'-6"
6"
HALF END ELEVATION FIG 288
3½"
END
SASH
FIG 289
SECTIONAL ELEVN B.B
FIG 293
PROTECTIVE
BAR FRAME
2" x 1"
SECTION AA
3/8 BRASS BARS
FITTED INTO
FRAME
2"
B
B
A
PLAN SHOWING
ONE LIGHT
IN POSITION
PUTTY
4"
FIG 292
4"
4"
CENTRE BAR
WATER TABLE
SCALES
FIG 296
6-0"
A
FIG 291
DRIP PIPE
3/8 DIAM
ALTERNATE FORM
OF HINGE
SKETCH SHOWING END
OF CROWN PIECE
JOINT TO
CROWN PIECE
FIG 294
FIG 295
WATER GROOVE
CARRIED THRO'
SOLID END
END
OF BAR
SHOWING JOINT WITH COAMING

are grooved on the upper edge, to receive a feather fixed into the sash, and also to form a water groove. The ends are grooved to take the cross tongues in the nosings.

A *crown piece*, or *ridge*, runs the full length of the skylight, a section of which is shown in Fig. 290; it is jointed to the ends by housing it into the depth of the water grooves, and then screwing and dowelling. This piece requires to be strong as it has to carry the whole weight of the upper end of the sashes; the one shown in the drawing is moulded out of a piece 6 in. by 5 in.; this size would have to be increased if the length of skylight exceeded 8 ft.

The plan of only a quarter of the skylight is shown, as both sides are symmetrical, and the length is simply a repeat of the part shown. The sashes, which should not be too large or heavy, are separated by *water tables*, fitted into the ridge and coaming, a section of one being shown in Fig. 292. The jointing is illustrated in Fig. 294. The water tables are designed to carry away the water at the junction of the sashes, and also to give extra support.

The **sashes** are mortised and tenoned together and should be pinned from the under side. They are hinged to the ridge by brass butts, or sometimes by a double strap hinge as shown in Fig. 296. A brass plate is screwed to the upper end of the sash where it abuts the ridge; it projects down into the water groove and prevents water being driven through by wind when the sash is open. The bottom rail is rounded off to suit the other nosings. Holes are bored through same and copper pipes are inserted to carry away the water collecting in the rebate for the glass.

The sashes are rebated on the upper side to receive a *barred frame* to protect the glass. This is necessary because these skylights are exposed on a weather deck, and the glass might easily be broken, by the falling of any portion of the rigging, or by other accidents. It is simply a frame fitted with brass or galvanised-iron bars, set about 2 in. centres. The frame is made portable and held in position by a bolt and wing-nut; this will be seen clearly on reference to plan and section, Figs. 289 and 291.

The skylight is **finished** inside by framing, and at the ends by a half water table, which is returned at the coamings. In the latter position the moisture will be chiefly due to condensation, and it is carried away by small copper tubes through the coamings. Section *BB*, Fig. 289, shows the encasing of the steel beam, and also the *quadrant*, which is operated by a wheel and screw, for raising the sashes. This skylight should be made in teak and all the joints painted with lead paint of similar colour.

The whole of the skylight can be made in the joiners' shop and transferred to the ship when completed. Of course, it is

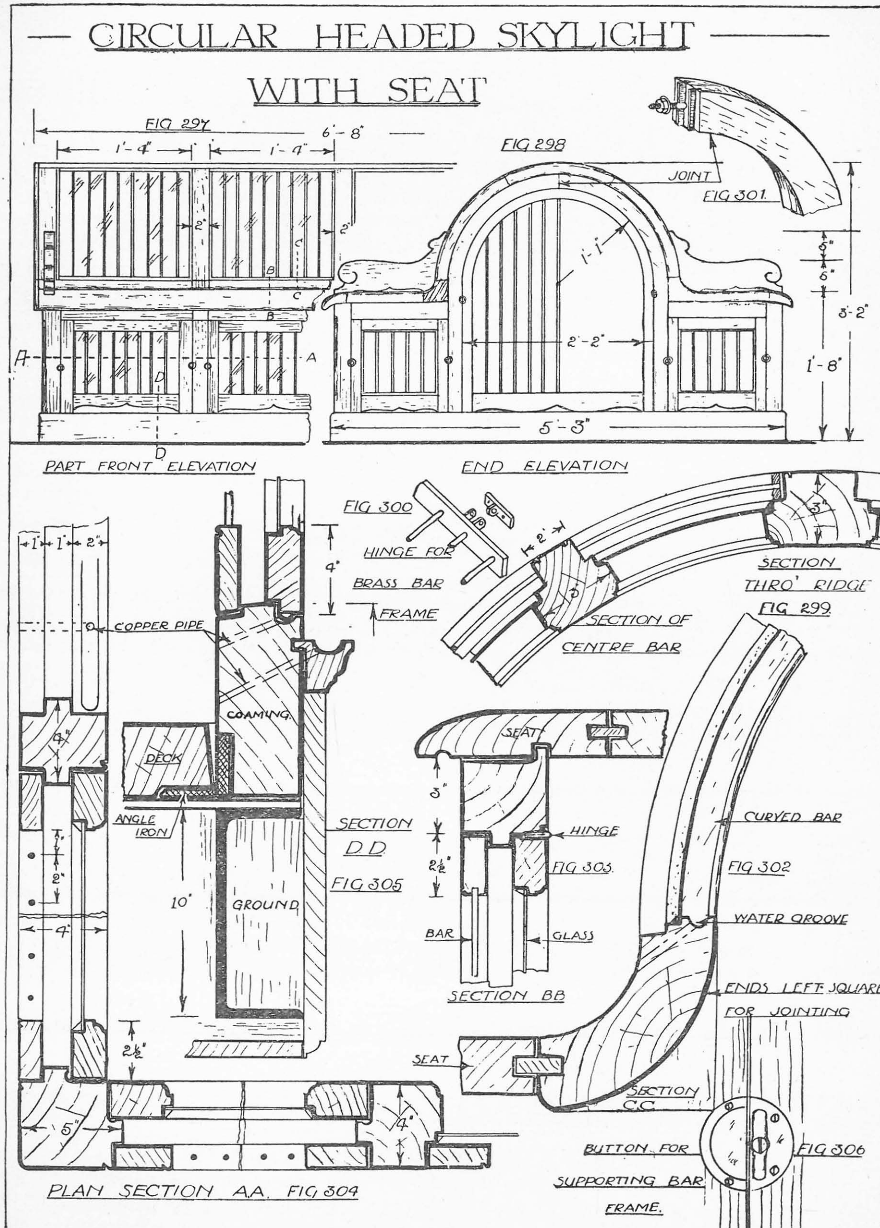
necessary to have the exact size, which can be obtained from the steelwork opening in the deck. The size of the opening can be taken either by skeleton, or by measuring the length, breadth, and two diagonals, from which its size can be laid out on a wood floor.

Circular-headed Skylight with Seats.—This type of skylight is particularly suitable where deck space is limited, and combines the seats in the same framework as the skylights. The top lights, that is the ones which are curved, are usually fixed, and as shown in Fig. 299 the glass is often fixed directly into the main framework. The smaller lights around the base are all made to open for ventilation, being hung at the top and opening to the inside.

Framed guards are placed over the glass which is often of highly decorated patterns. These guards are framed up in the ordinary way, as previously described, but the upper ones, which are curved, are entirely of brass riveted together, the wood frame being omitted. They are hung at the top, as shown in Fig. 300, and slip bolts hold them in place at the lower edge.

No description is required of the coamings, as these are similar to ones previously described. There is a main framing filled in with sashes and bar frames. The main framing is composed of standards, mortised to the coaming, and to an upper rail carrying the seat. Special arrangement is required with the circular ends; in this case, the standards are carried round the curves, and jointed in four pieces, as shown in Fig. 298. The joint is formed by means of cross tongues and handrail bolts, as shown in sketch, Fig. 301.

The seat is then fitted, the joints being made watertight, and the centre bars are jointed into the ridge. The sections for ridge and bars are shown in Fig. 299, and the jointing for seat in Fig. 302. A water groove is worked on the upper edge of the seat, and about three $\frac{3}{8}$-in. copper tubes are inserted in the length to carry away condensation moisture. The arms for the seat are fixed by screwing and dowelling, and the under edge is left open to allow water collecting on the seat to escape. Various ornamental designs are adopted for these ends, those shown in Fig. 298 being common designs. The plan, section *AA*, Fig. 304, gives an idea of the arrangement of the sashes between the standards. Vertical section *DD*, Fig. 305, shows the method of dealing with leakage water where the sash and coaming join. A groove is cut to receive the water, and a copper pipe is inserted to carry it through the coaming. A similar arrangement carries the condensation moisture collected in the mould inside the coaming. This vertical section also shows a method of dealing with the "covering in" of a fore-and-aft deck beam. The upper rail of sash and method of hanging sash are shown in Fig. 303,


CIRCULAR HEADED SKYLIGHT
WITH SEAT
FIG 297
6'-8"
1'-4"
1'-4"
2"
2"
A
A
B
B
C
C
D
D
PART FRONT ELEVATION
FIG 298
JOINT
FIG 301.
1'-1"
2'-2"
5"
6"
3'-2"
1'-8"
5'-3"
END ELEVATION
FIG 300
HINGE FOR
BRASS BAR
FRAME
2"
3"
3"
SECTION
THRO' RIDGE
FIG 299.
SECTION OF
CENTRE BAR
1"
1"
2"
COPPER PIPE
4"
COAMING
DECK
ANGLE
IRON
SECTION
D.D.
FIG 305
10"
GROUND
2"
4"
2½"
5"
4"
PLAN SECTION A.A. FIG 304
SEAT
3"
HINGE
2½"
FIG 303.
BAR
GLASS
SECTION BB
CURVED BAR
FIG 302
WATER GROOVE
ENDS LEFT SQUARE
FOR JOINTING
SEAT
SECTION
C.C.
BUTTON FOR
SUPPORTING BAR
FRAME.
FIG 306

section *BB*. The frames, with protective bars, are mortised together, and are fitted into rebates in the main framing. They are portable and are held in position by means of buttons, as shown in Fig. 306.

Hipped Skylight.—Hipped skylights have the advantage over ordinary pitched skylights in that they have no solid ends to obstruct the light. They are, however, much more difficult to construct. In the one shown, sashes are fitted between the water tables, but in many cases the glass is fitted directly into the latter. Arrangement is made for ventilation by means of *metal ventilators* fitted into the ridge; this provides a means of ventilating the space below when the weather is too severe to open the sashes. The plan and elevation of this skylight are shown in Figs. 307 and 308.

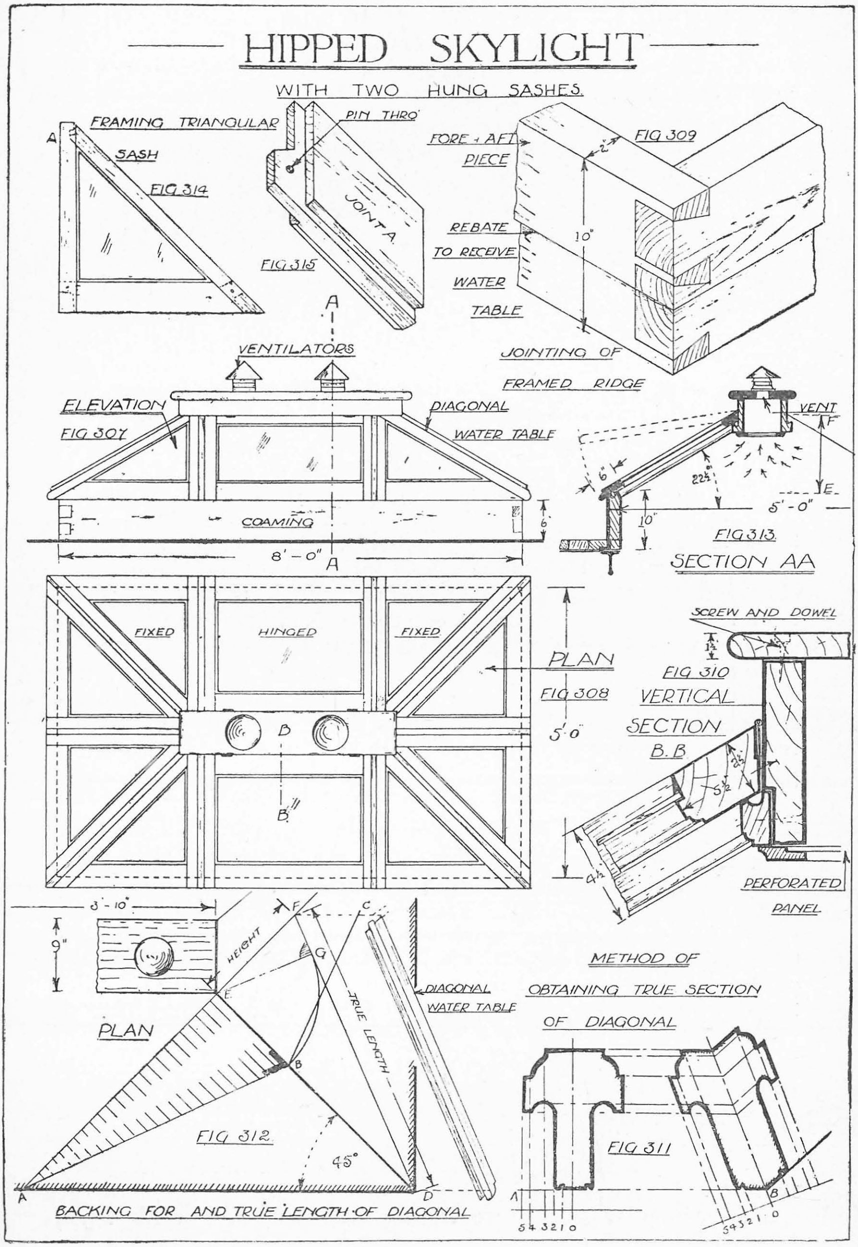
The ridge is framed up by dovetailing the corners, as shown in Fig. 309; the top of which is screwed down, and the holes are made good by dowels. The metal ventilators are screwed to the top, painted canvas being placed in the joint to make it watertight. The under side of the ridge is rebated to receive the half water table, as shown in section *BB*, Fig. 310, the latter being fixed by screwing from the inside.

A section of water table is shown in Fig. 311, and the method of finding the section of a diagonal water table is shown in same figure. This should be clear from the drawing; the angle *ABC* is the *dihedral angle* between the two planes containing the sashes. The distances *01, 12, 23,* etc., are copied from the ordinary section, on to a line *50* perpendicular to a line intersecting the angle *ABC*. The points are then projected to meet the lines corresponding to these points which are projected parallel to *ABC*.

The method of finding the length of the diagonal water table from a single line diagram is shown in Fig. 312. On the plan of the diagonal *DE* is set up the vertical height *EF*, taken from section *AA*, Fig. 313; the line joining *DF* gives the *true length* required. The diagonal and joints are also shown in full. On Fig. 312 is also shown the method of finding the dihedral angle, or "backing," for hip, which is required to set out the *true shape* of the section and is copied to Fig. 311. To do this, the length of a line *EG* perpendicular to *DF* is swung round to meet *DE* in *B*; and by joining *A* to *B* and *B* to *C* the required angle is found; the bevel for setting out the section is shown applied to the angle *ABE*.

The water tables are scribed and mortised to the ridge, and checked to the coaming, in order to allow the water to drip clear of same. The latter joint is similar to that for an ordinary skylight.

The triangular sashes are framed up, as shown in Figs. 314


HIPPED SKYLIGHT
WITH TWO HUNG SASHES.
FRAMING TRIANGULAR SASH
FIG 314
PIN THRO'
JOINT A.
FIG 315
FORE + AFT PIECE
FIG 309
REBATE TO RECEIVE WATER TABLE
10"
JOINTING OF FRAMED RIDGE
VENTILATORS
ELEVATION FIG 307
DIAGONAL WATER TABLE
COAMING
6"
8' - 0"
VENT
22½°
5' - 0"
FIG 313.
SECTION AA
FIXED
HINGED
FIXED
PLAN FIG 308
5' 0"
SCREW AND DOWEL
FIG 310
VERTICAL SECTION B.B
PERFORATED PANEL
3' - 10"
9"
HEIGHT
TRUE LENGTH
DIAGONAL WATER TABLE
PLAN
FIG 312
45°
BACKING FOR AND TRUE LENGTH OF DIAGONAL
METHOD OF OBTAINING TRUE SECTION OF DIAGONAL
FIG 311

and 315, and are pinned from the under side. They are fixed in position by nailing, and copper tubes are inserted in the bottom rail to carry away the rain water. The bottom rail is also made watertight by painting and inserting a *feather* into the coaming.

Protective bars and frames though not shown in drawing to avoid confusion, are fitted as explained for previous examples.

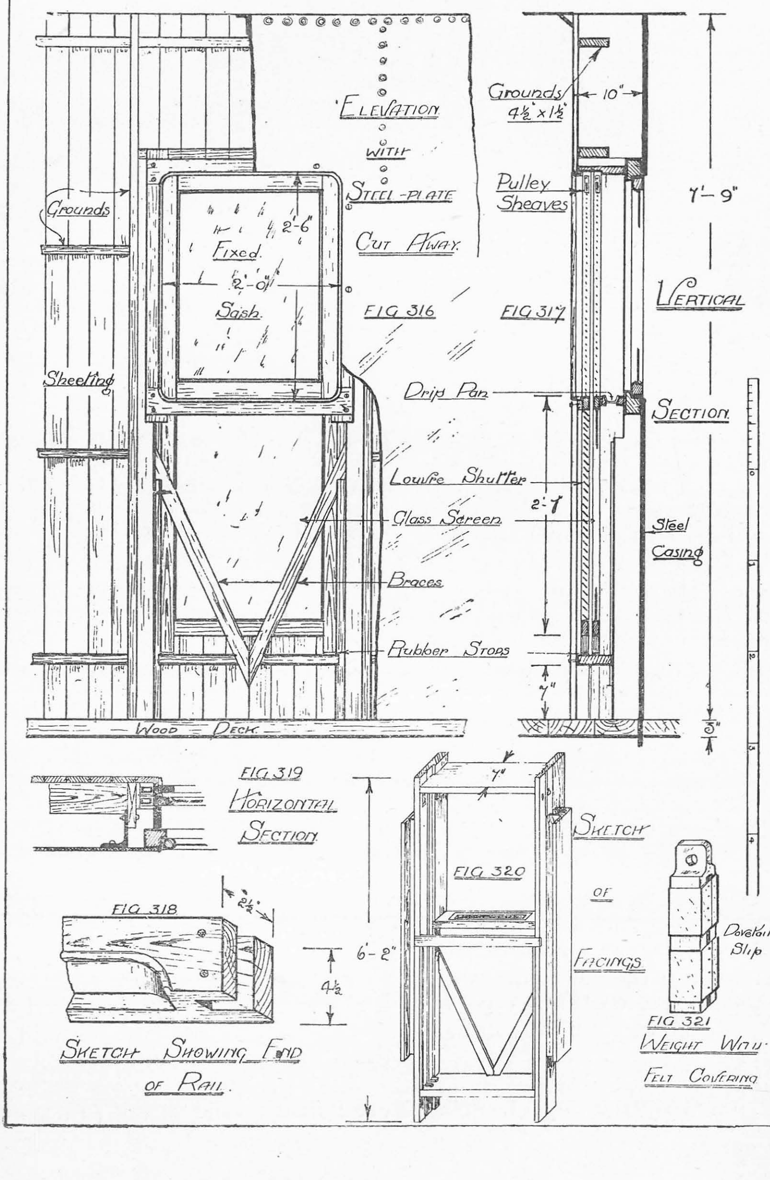
The inside of skylight is finished off by fixing an ornamental perforated grid to allow a free circulation of air. This grid is held in position by a moulded frame fixed to the ridge, as shown in section, Fig. 310.

Window and Casing in Steel Deck-house.—It is possible to cut larger openings into deck-houses than into the ship's side, thus making it possible to have larger windows in the former. The openings are usually rectangular with round corners, and all the information required in the shop for each window is the *bevel*, which is taken from the opening, the *height* and *width* of opening—which may be the same for quite a number of windows—and the radius for the round corner.

The window and casing here illustrated is suitable for a state-room on a promenade or shelter deck. The window itself is of the casement type and composed of solid frame and sash of teak. It is set out in elevation, Fig. 316, where part of the steelwork is shown cut away. The outline of the projecting bead is exactly the same size as the opening. The frame is rebated to receive the sash, and is splayed in order to obtain a "wedge-shaped" fit, which can be made closer and more watertight than the square rebate. The bridle joint at the angle is shown in Fig. 318 and is screwed and painted. The frame is fixed to the steelwork by screwing through from the face of the plate; it should be bedded in thick lead paint. The sash is mortised and tenoned together at the angles, and is rebated to receive the glass which is bedded in putty and held in by splayed beads. It is sometimes made stronger by screwing small brass plates around the corners.

The casing is of teak, and is made up of two *pulley stiles, head, sill,* and *bottom rail.* The pulley stiles have a "double race," one for a sliding *glass screen* and one for a *Venetian louvre* screen; see sections, Figs. 317 and 319. Pulleys are fitted near the top, over which the chain works which carries the balance weights; and a *parting bead* is set into a groove to keep the two screens apart. The head and sill are housed into the stiles, and into the sill is fitted a *drip pan* to receive leakage or condensation moisture. The bottom rail acts as a ground to which the sheeting is fixed, and also as a stop for the screens. Small pieces of rubber are fastened to the bottom rail to act as a *buffer* when the screens are lowered, and to prevent the glass being broken by the impact. *Braces* are nailed to the casing to keep

WINDOW AND CASING



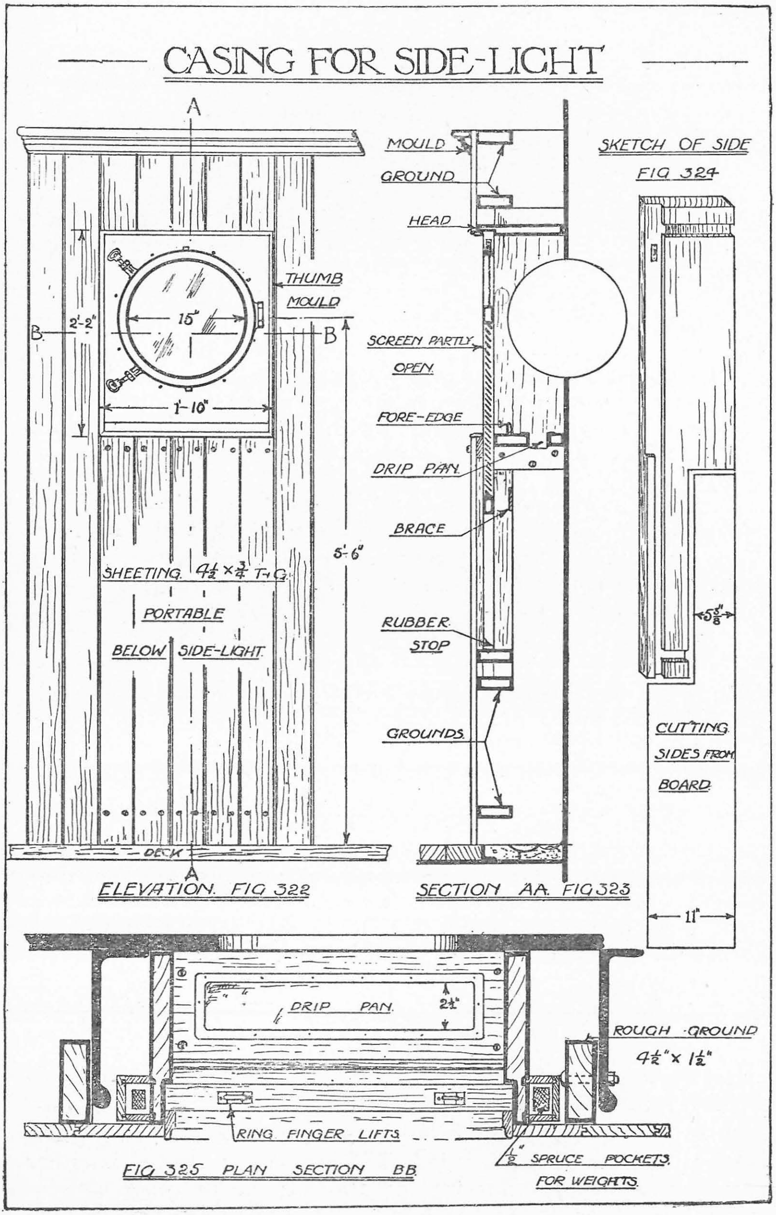
it to the proper bevel when being taken to the ship, and to allow of the correct fitting of the screens while in the shop.

Light framed *spruce pockets* are nailed together and fastened into grooves on the outer sides of the casings. These will be seen clearly in Fig. 320. The side next the sheeting can be left open and the sheeting or framing allowed to form one side of the pocket. The *weights*, which are sometimes of cast-iron and sometimes of lead, are made to receive a wooden dovetail slip on one edge to allow for the fastening round of felt, as shown in Fig. 321. This is necessary to prevent the rattling of the weights in the pockets, due from the rolling of the ship.

The glass screen is framed up and fitted with some kind of obscure glass, thus giving light to the state-room and at the same time obscuring any view from the deck outside. The louvre shutter can be used when it is necessary to have a light in the state-room. Both screens are hung on copper chains and can be raised or lowered at will. The outside sash is sometimes fixed, and sometimes made to open for purposes of ventilation. Where vessels pass through mosquito infested areas, mosquito screens are fitted in addition to those already mentioned. These mosquito screens are simply framed screens, having fine mesh expanded metal to prevent the entrance of mosquitoes, and yet allowing a plentiful supply of fresh air.

Casing for Side-light.—The casing shown in Figs. 322 to 325 is similar in some respects to the one previously described, except that no window frame is included, its place being taken by the side-light which opens on a hinge at the top and is held tight in place by bow handles and screws, a ring of rubber forming the joint. This side-light is chiefly used in the 'tween decks, whereas the large window previously described is more suitable for a deck-house.

The casing is made up of two pulley stiles, in this case with a single race; a sketch is shown in Fig. 324. The head and bottom rails are housed; but the sill in this case is fitted in the ship, the reason for this being that it is very essential to have a water-tight joint between the sill and ship's side plating, as there is considerable leakage, and water driven in by rain in this type of side-light. The sill is bedded in thick paint and screwed to fillets which in turn are screwed to the pulley stiles. A drip pan, shown in section, Fig. 323, is fitted into the sill, and its length should be such as to cover with a little allowance the width of the side-light; for example, a 15-in. side-light should have a drip pan 16 in. long. The drip pan is of thin copper and nailed close into an opening cut into the sill; its width is about 2 in. and depth 1 in. The moisture collected is either periodically sponged out by the steward, or in some cases a small pipe is arranged to carry away the moisture. A *fore-*


CASING FOR SIDE-LIGHT
A
B
2'-2"
15"
1'-10"
THUMB MOULD
B
5'-6"
SHEETING. 4½ × ¾ T+G.
PORTABLE
BELOW SIDE-LIGHT.
DECK
A
ELEVATION. FIG 322
MOULD
GROUND
HEAD
SCREEN PARTLY OPEN.
FORE-EDGE
DRIP PAN.
BRACE
RUBBER STOP
GROUNDS.
SECTION AA. FIG 323
SKETCH OF SIDE
FIG 324
5⅝"
CUTTING SIDES FROM BOARD.
11"
DRIP PAN.
2¼"
ROUGH GROUND
4½" × 1½"
RING FINGER LIFTS
½" SPRUCE POCKETS. FOR WEIGHTS.
FIG 325 PLAN SECTION BB.

edge is fixed on the inside of the drip pan to prevent any water finding its way down inside the screen. An economical method of cutting the pulley stiles is shown in Fig. 324.

The finishing round the casing is shown in elevation, Fig. 322. The sheeting below the side-light is made portable, being held in position by snap-head screws. This is to facilitate the repainting below the side-light as the steel there is particularly liable to corrosion. The screen is held in by a narrow moulding, which projects a little beyond the face of the sheeting, and a pocket is provided to receive the weights, as shown clearly in plan, Fig. 325. The casing is held in position by nailing to grounds, one above and one below. In many cases this window is draped with small curtains hung with rings and curtain rod.

Louvre, or Jalousie, Screen.—These screens are used chiefly in state-rooms in connection with the windows and side-lights previously described. They are often made of wood either similar, or to give a contrast, to the other state-room furnishings.

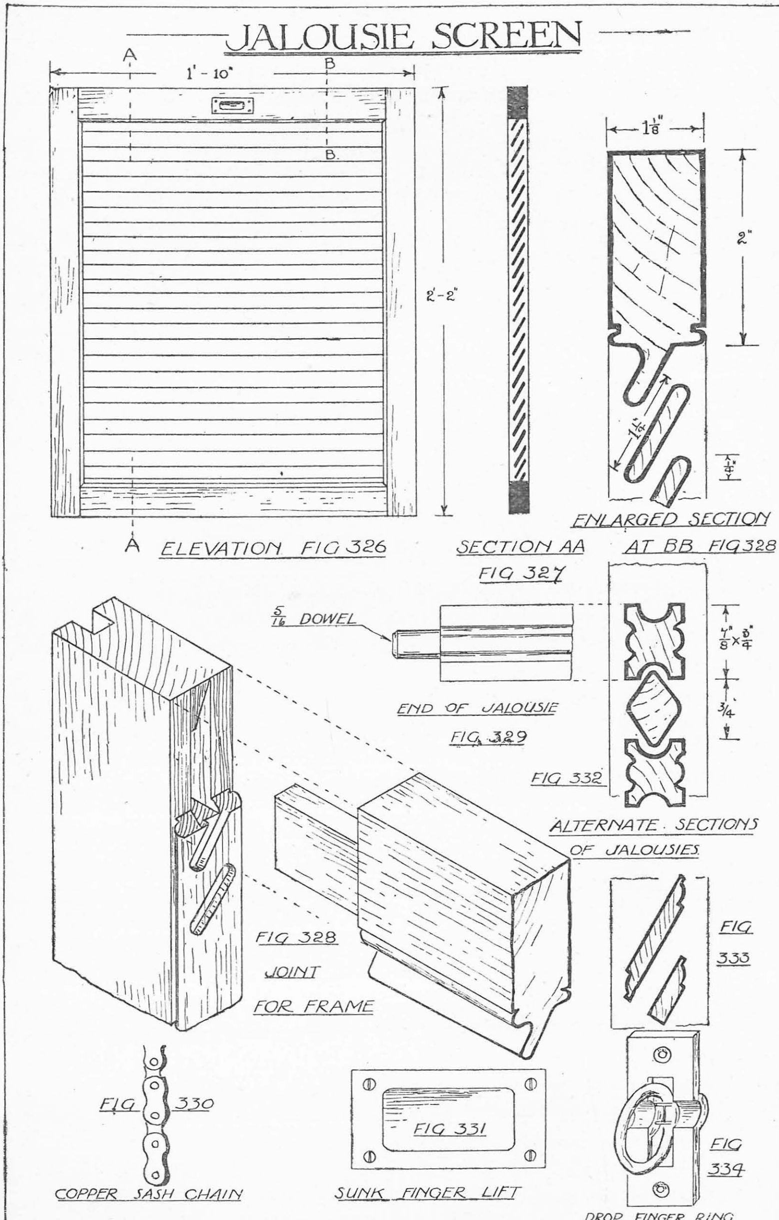
Their chief purposes are to obscure the view, to give privacy to the occupants of the room, and to provide ventilation. They are mostly balanced by weights and made to slide vertically, but in some cases they run horizontally on ball-race runners.

The one shown in Fig. 326 is an ordinary type. It is mortised and tenoned together with a splayed haunch, to show a square joint on the upper edge; see Fig. 328. In this figure is also shown the section of the top rail, in which the top louvre is run on the solid. This is a better method than a loose louvre, as the latter is difficult to fix and often results in an open joint. The *louvres* are housed into the stiles to a depth of $\frac{3}{16}$ in. The sinkings are made by a special *slotting machine,* and are done in pairs so that they are exactly alike. The revolving drill is inserted to the depth; and the table to which the stiles are fastened travels at the proper angle, and to just the necessary distance. By means of a ratchet the table can be moved to the next slot and the same operation repeated. The screen is glued together and wedged, after which grooves are cut on the outer edges to receive the chain or cord for hanging. A common type of *copper chain* used for this purpose is shown in Fig. 330.

A *finger lift* is sunk into the top rail, for lowering or raising the screen. In order to raise the screen when flush with the sill two drop rings are housed into the top rail; sketches of these are shown in Figs. 331 and 334. Knobs are often used instead of the drop rings, and holes are bored into the head of the casing to enable the screen to fit tightly up to the head when closed.

Different sections of *jalousies* are shown in Figs. 328 and 333, and a method of fixing the square ones by a dowel is shown in Fig. 329.

Saloon Window.—The saloon window under consideration


JALOUSIE SCREEN
A
B
1' - 10"
B.
2'-2"
A
ELEVATION FIG 326
SECTION AA
FIG 327
1⅛"
2"
1¼"
¼"
ENLARGED SECTION
AT BB FIG 328
5/16 DOWEL
END OF JALOUSIE
FIG 329
7/8" × 3/4"
3/4
FIG 332
ALTERNATE SECTIONS
OF JALOUSIES
FIG 328
JOINT
FOR FRAME
FIG
333
FIG 330
COPPER SASH CHAIN
FIG 331
SUNK FINGER LIFT
FIG
334
DROP FINGER RING

is suitable for a public room in a deck-house. Where large windows are required in the 'tween decks, light is often admitted through the ordinary port-holes, as many as four or six of these being utilised to supply light, which is often diffused through a large leaded or decorated glass window. As previously mentioned, this arrangement is used because it is impossible to cut large openings into the shell plating.

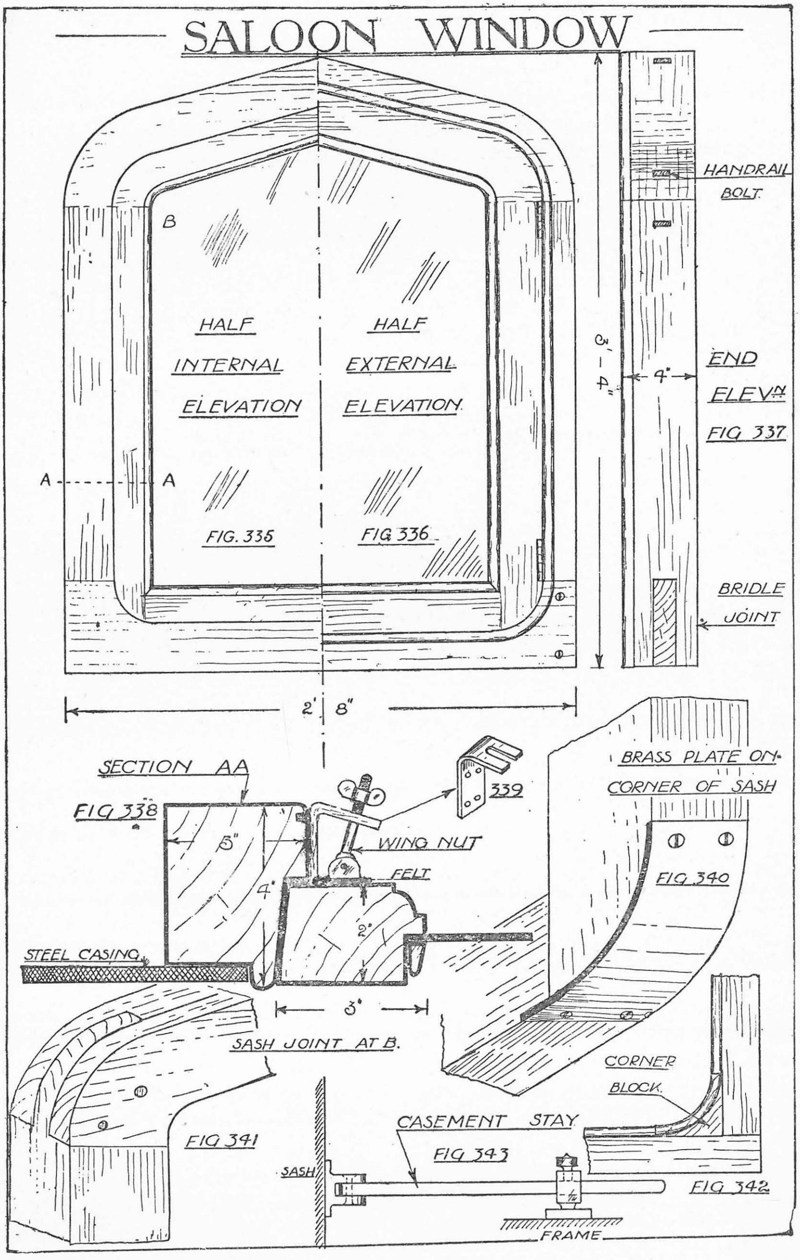
The forms and styles of saloon windows are so many and varied that it would be impossible to deal with them in much detail. They are usually designed to suit the panelling and decoration of the room, and often form an important feature in the general design. The window chosen for illustration has a solid frame and sash, with a Tudor-arch shaped head. The external features have been omitted to show the construction clearer, and in all probability no screen or casing would be used in this case. Privacy is not necessary in the public rooms, and often the windows are tastefully draped, being hung with curtains and the necessary fittings.

The solid frame is similar to other types previously described, with the exception of the head, which requires a little explanation. It is made up in two parts, and *butt jointed* with two cross tongues, while it is held together by handrail bolts. The curve at the springing is regulated by the radius of the curve cut in the steel, which is the same as the curve on the bottom rail. With reference to the *bevel* for windows of this type, it may be necessary to make a skeleton or templet to fit the openings; but it should be borne in mind that the continued line from one springing to the other should follow the *sheer* of the deck at that particular point. In fixing the frame together the top joint would be fastened first, then the joint at the springings, and the bottom rail fixed last; see elevations, Figs. 335 to 337.

The joints of the sash should be made and pinned as shown in Fig. 341, and the top rail of the sash could be cut out of the solid. In large sashes, such as this one, a brass plate is sunk flush into the corner, as shown in Fig. 340; this gives extra strength to the sash, which has to withstand considerable strain.

Section *AA*, Fig. 338, gives sections of the frame and sash, and shows a common fastener for screwing the sash tight up against the rebate, which is covered with thick felt. The hinged wing nut, as shown, holds the sash quite steady, prevents rattling, and assists in keeping out driving rain and wind. The sash is held when open by a casement stay, as shown in Fig. 343.

Fig. 342 shows a method of saving material where a large round corner has to be made. Instead of working the corner on the solid rail, it is fixed in as a separate piece. By this method, short grain at the angle can be avoided, but it entails extra labour in fitting and fixing.


SALOON WINDOW
HALF INTERNAL ELEVATION
HALF EXTERNAL ELEVATION
FIG. 335
FIG. 336
B
A
A
2' 8"
3' - 4"
4"
HANDRAIL BOLT
END ELEVN
FIG 337
BRIDLE JOINT
SECTION AA
FIG 338
5"
4"
2"
3"
STEEL CASING
WING NUT
FELT
339
BRASS PLATE ON CORNER OF SASH
FIG 340
SASH JOINT AT B.
FIG 341
CORNER BLOCK.
FIG 342
CASEMENT STAY
FIG 343
SASH
FRAME

CHAPTER VIII

GEOMETRY OF SHIP JOINERY

IN this chapter it is proposed to show the more important applications of geometry to setting out pieces of work. It is impossible in a book of this kind to deal at much length with the underlying principles of geometry, but an endeavour has been made to give the most important applications of the science to practical problems met with by the craftsman.

Figs. 344 to 354 show some elementary constructions in *plane geometry*, that is, the geometry of flat outlines.

Dividing Distance into Equal Parts.—Fig. 344 shows a geometrical method of dividing 2 in. into five equal parts. The ruler is simply skewed across the width, until five equal divisions on it coincide with the width to be divided, when the divisions are marked with the point of the scriber. The gauge can then be set to the points thus marked, and applied to gauging twin tenons, as shown in drawing, or for any similar purpose required.

Fig. 345 shows a further application of this principle. This time 2 in. is divided into twelve equal parts, for **making a scale** of 2 in. to 1 ft., the 2 in. being divided into twelve equal parts to represent inches. The drawing also shows the numbering of the scale and the method of reading same.

Bisecting an Angle.—Fig. 346 illustrates the method of bisecting an angle *ABC*. With *B* as centre draw an arc, cutting the lines *AB* and *CB* in *A* and *C*. With *A* as centre swing round an arc, and also with the same radius describe an arc having centre *C*. Join *D*, where the two arcs intersect, to *B*, and this line will bisect the angle. The drawing shows its application to finding the intersection, or mitre, of the members in ceiling mouldings which are planted on, to form a design. The bevel for marking mitres can be set to the angle *CBD*. A section of such a ceiling mould is also shown.

Constructing Regular Pentagon.—Fig. 347 shows a method of setting out a regular pentagon, that is, a regular polygon having five sides. Draw one side *AB* horizontal and on it, with *AB* as radius, draw a quadrant. Divide the quadrant into five equal parts by trial, and draw from *A* to *3*. Next draw a perpendicular from the centre of the base, and where this line and *A3* intersect will give the centre of a circle containing the figure. Draw in the circle ; step off the length of side round the curve ; and join up the points thus found.

Equilateral Triangle and Trefoil.—Fig. 348 shows the drawing of an equilateral triangle by swinging round the base length AB in the compasses, first from A and then from B; where the two arcs intersect will be the apex of the triangle. This construction is used in setting out a *trefoil,* by drawing circles with their centres on each corner of the triangle, and radius equal to half the length of the side.

Construction of Hexagon.—Fig. 349 gives the construction of a hexagon on a given base. On the base draw an equilateral triangle, the apex of which is the centre of a circle containing the figure, and the length of side can be stepped off around the curve. This construction is used in setting out laggings for insulated columns, also for cooper jointing in any circular work divided into six parts.

Drawing an Octagon in a Square.—Fig. 350 shows a method of drawing a regular octagon in a square. This is done by setting off, from each corner, half the diagonal of the square, and joining up the points. This method is used in setting out an octagonal table leaf suitable for a lounge or smoke-room.

Drawing Curve through Three Points.—Fig. 351 shows two methods of finding the centre of a segment to pass through three given points. Join the three points by chords AB and BC. Bisect the chords by perpendicular lines, and their intersection will give the centre for the circle. The perpendicular line to BC is found by applying a square to the centre of the length, but a geometrical method is shown on AB. Draw two arcs of the same radius, one with A as centre and the other with B as centre; a line drawn through where the arcs cut will be the line of bisection.

Obtaining Radius by Calculation: To calculate the radius of a circle to pass through three given points, let

$c=$ the chord of the arc AC;
$r=$ the radius;
and $h=$ height of the arc DB.

Then the radius can be calculated from the following formula:

$$r=\frac{c^2+4h^2}{8h}.$$

Example.—Taking the chord c as 4 ft. and the height h as 1 ft., find the radius r, thus:

$$r=\frac{4^2+(4\times 1^2)}{8\times 1}$$
$$=\frac{16+4}{8}=\frac{20}{8}=2\tfrac{1}{2}\text{ ft.}$$

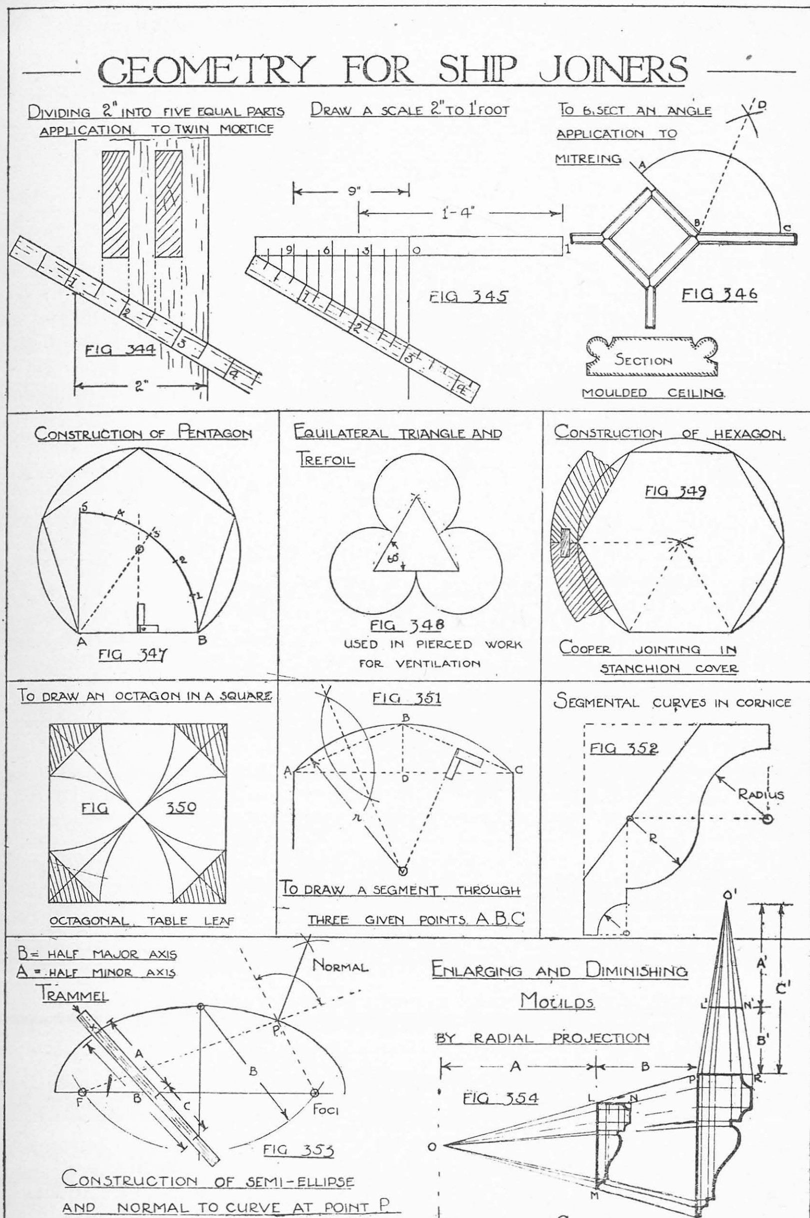

GEOMETRY FOR SHIP JOINERS
DIVIDING 2" INTO FIVE EQUAL PARTS
APPLICATION TO TWIN MORTICE
FIG 344
2"
1 2 3 4
DRAW A SCALE 2" TO 1' FOOT
9"
1'-4"
9 6 3 0 1'
FIG 345
TO BISECT AN ANGLE
APPLICATION TO
MITREING
A B C D
FIG 346
SECTION
MOULDED CEILING
CONSTRUCTION OF PENTAGON
A B
5 4 3 2 1
FIG 347
EQUILATERAL TRIANGLE AND
TREFOIL
60°
FIG 348
USED IN PIERCED WORK
FOR VENTILATION
CONSTRUCTION OF HEXAGON.
FIG 349
COOPER JOINTING IN
STANCHION COVER
TO DRAW AN OCTAGON IN A SQUARE
FIG 350
OCTAGONAL TABLE LEAF
FIG 351
A B C D
TO DRAW A SEGMENT THROUGH
THREE GIVEN POINTS. A.B.C
SEGMENTAL CURVES IN CORNICE
FIG 352
RADIUS
R
B = HALF MAJOR AXIS
A = HALF MINOR AXIS
TRAMMEL
NORMAL
P
A B C
F
FOCI
FIG 353
CONSTRUCTION OF SEMI-ELLIPSE
AND NORMAL TO CURVE AT POINT P
ENLARGING AND DIMINISHING
MOULDS
BY RADIAL PROJECTION
A B C
FIG 354
O L N M P R Q
O' L' N' R'
A' B' C'

Fig. 352 shows the application, of drawing segmental curves, to the setting out of a section of cornice mould.

Constructing Ellipse.—The construction of an ellipse by the *trammel* method is shown in Fig. 353. The major and minor axes are set out at right angles to one another, each bisecting the other. A trammel is then prepared—if for drawing, a piece of paper will serve the purpose, but in the workshop a thin lath is used. The length B, equal to half the major axis, is set off on the trammel; and length A, equal to half the minor axis, is set off from one end of B. The difference between the lengths A and B—that is the length C—is worked around the axes; and at the different positions of the trammel, points are plotted opposite the point marked X. A fair curve drawn through these points will give the required ellipse.

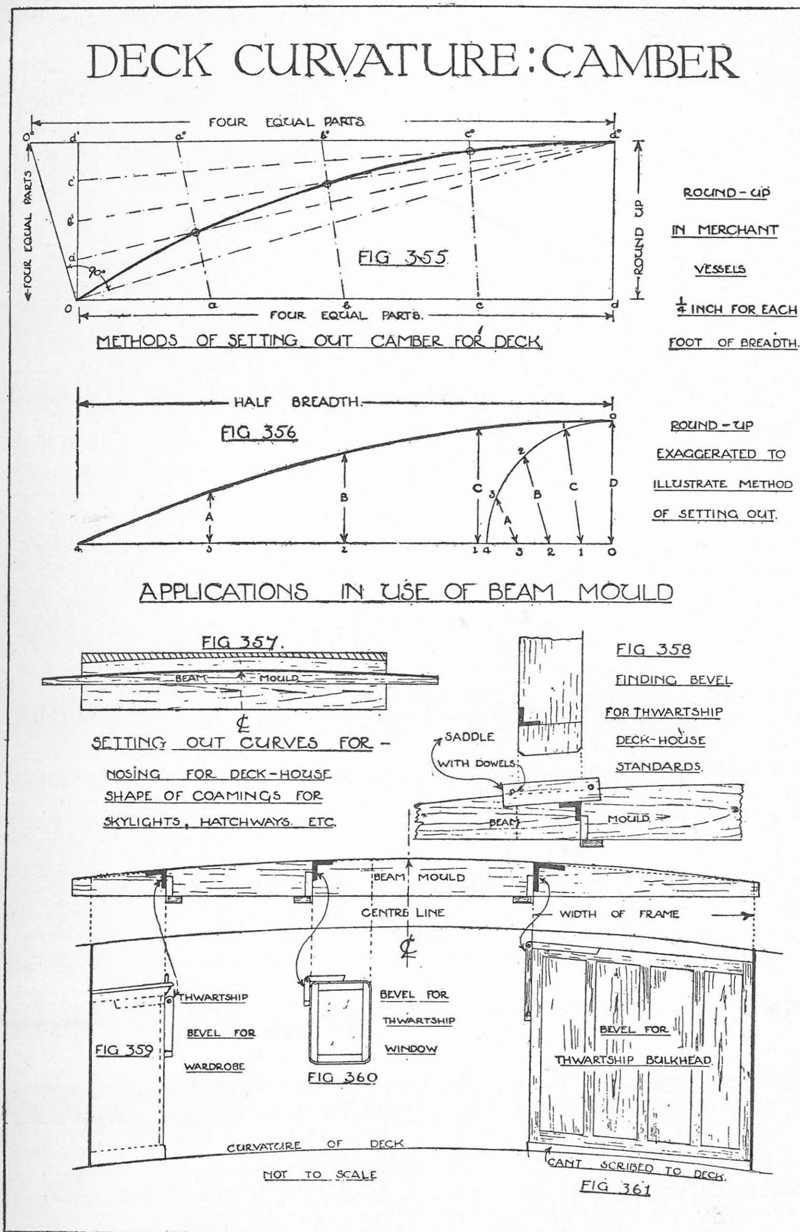
Suppose it is required to find the joint line, say in an elliptical window head, and suppose the joint to be opposite the point P. First find the two *foci*, by drawing an arc with centre E and radius equal to length B. Draw from the focal point F through P, and bisect the angle made by these two lines. This bisecting line will give a normal, or joint line, to the curve at P. And a tangent to the curve at point P can be found by drawing perpendicularly to the normal.

Enlarging and Diminishing Mouldings.—A method of enlarging or diminishing a moulding is shown in Fig. 354. Assume a $1\frac{1}{2}$-in. moulding-section requires to be enlarged to $2\frac{1}{2}$ in. Dealing first with the width, project the arrises of the members back horizontally to LM. From a point O, draw radially through these points until the radial lines intersect PQ. The perpendicular distance B from LN to PQ can be found from the ratio $A : C = 1\frac{1}{2} : 2\frac{1}{2}$; therefore divide A into three parts and add two of them to give the distance B. Referring now to the thickness of moulding: draw $L'N'$ any distance from PR and copy the points LN to $L'N'$. Draw from P through L' to meet O'. The point O' can be found by making A' to C' the same ratio as in A and C. Draw a line from O' through N' to R, thus making PR the increased width, and likewise draw through the intermediate points. With PQ and PR divided, draw horizontal and vertical lines to give the arrises of members on the enlarged section, and complete the outline.

To reduce a moulding-section the reverse procedure would be adopted.

DECK CURVATURE: CAMBER

Reasons for Camber.—The curvature given to the decks athwartship, or in the direction of the deck beams, is known as the *camber*. The weather decks are all cambered for the pur-


DECK CURVATURE: CAMBER
FOUR EQUAL PARTS
FOUR EQUAL PARTS
ROUND UP
FOUR EQUAL PARTS.
FIG 355
90°
METHODS OF SETTING OUT CAMBER FOR DECK.
ROUND-UP IN MERCHANT VESSELS ¼ INCH FOR EACH FOOT OF BREADTH.
HALF BREADTH.
FIG 356
ROUND-UP EXAGGERATED TO ILLUSTRATE METHOD OF SETTING OUT.
APPLICATIONS IN USE OF BEAM MOULD
FIG 357.
BEAM MOULD
SETTING OUT CURVES FOR -
NOSING FOR DECK-HOUSE
SHAPE OF COAMINGS FOR SKYLIGHTS, HATCHWAYS. ETC.
FIG 358
FINDING BEVEL FOR THWARTSHIP DECK-HOUSE STANDARDS.
SADDLE WITH DOWELS
BEAM
MOULD
BEAM MOULD
CENTRE LINE
WIDTH OF FRAME
THWARTSHIP BEVEL FOR WARDROBE
FIG 359
BEVEL FOR THWARTSHIP WINDOW
FIG 360
BEVEL FOR THWARTSHIP BULKHEAD.
CURVATURE OF DECK
NOT TO SCALE
CANT SCRIBED TO DECK.
FIG 361

pose of draining off the water to the ship's side; also, by cambering the deck beams, the latter are enabled to withstand greater loads, as each one acts like an arch. The amount of camber, or "round-up," for a merchant vessel is usually a $\frac{1}{4}$ in. per ft. of beam: for example, suppose a vessel has a 40-ft. beam; then the height of the deck at the centre of the beam would be $40 \times \frac{1}{4} = 10$ in. above a level line drawn from the ship's side. Of course, in passenger vessels there seems to be no fixed rule, only the round-up is often much less, and the floor or decks of dining saloons are often made level.

Setting Out the Camber.—The curve adopted is usually part of a *circle*, and two methods of setting out the curve are shown in Figs. 355 and 356. In both cases, it will be noted that the amount of round-up is considerably increased in order to make the diagrams more clear. In Fig. 355 the *half breadth* is set out horizontally, the round-up is set up perpendicularly to it, and the rectangle is completed by drawing parallels. A diagonal is then drawn from o to d°, and a perpendicular is drawn on the end of the diagonal od°; the line $d^{\circ}d'$ is extended to meet it in o°. The two horizontal lines are then divided into four equal parts a, b, c, d, and a°, b°, c°, d°, and lines are drawn connecting aa°, etc. Next, the perpendicular line od' is divided into four equal parts a', b', c', and d', and lines from these points are joined up to d°. Where these lines intersect are points on the curve, and through these a fair curve is drawn. If extra points are taken it will be possible to get a more correct curve. The points found are mathematically correct, and if the curve is cut out it should fit any other part of the circle.

Fig. 356 is an easy method of finding an approximate curve. Divide the half breadth into four equal parts and draw D equal to the round-up and perpendicular to the half-breadth line. Draw a quadrant with centre O and radius D, and divide the curve into four equal parts; also divide the base line of the quadrant into four parts, and join *1* to *1*, *2* to *2*, etc. Set up, on perpendiculars at the four divisions of the half-breadth, lengths equal to A, B, and C, and through the end points of these perpendiculars draw a fair curve.

The camber curve is thus drawn on the mould-loft floor, and a lath and pins are used to obtain a fair curve. From this curve is made a *beam mould*, which has many uses in the workshop in setting out pieces of work.

Fig. 357 shows its use in marking out thwartship coamings. It is first necessary to know the position of the coaming relative to the ship's fore-and-aft centre line. Coamings for skylights, deck-houses, or hatchways could all be marked in this way. The curves could be cut on the band saw, which would subsequently save a lot of work in scribing to the deck.

Athwartship's Bevels.—Fig. 358 shows a method of finding the bevels for the standards of a deck-house. The position of the standard is allocated on the beam mould and two lines are squared up to show its position. A saddle can be used to obtain a tangent to the curve over a limited length, by having two dowels inserted in a piece of wood parallel to the edge, as shown in the sketch. The square can then be applied to the straight-edge of the beam mould, and the bevel to the square and the saddle. The bevel is applied to the standard, as shown in drawing.

Fig. 359 shows the position of a wardrobe, and the method of obtaining its thwartship *bevel* from the beam mould, which is shown directly above. The same bevel could be applied to a wardrobe on the opposite side of the ship.

Figs. 360 and 361 show methods of finding bevels by applying the square and bevel to the beam mould. It will be noted that, in the case of the framing, a straight line, connecting up the lines representing the width of frame, is dotted on the beam mould; and the bevel is set to this dotted line and not to the edge of the beam mould. The cant being scribed to the deck takes away the curved line and presents a straight joint to the frame. The same applies in the case of the runner; it is fixed straight and parallel to the deck cant.

Sheer.—The fore-and-aft curvature of a deck is called the *sheer*, and the amount of sheer is regulated by the size and design of the vessel. The forward sheer is usually about twice that of the after sheer. The amount of sheer is the height measured from a horizontal line drawn from the lowest point of the deck. The lowest point is sometimes at midships and sometimes a little distance abaft midships.

The mean sheer (that is, the forward plus after sheer, divided by two) is sometimes calculated by *dividing the length in feet by ten, and adding ten,* the result being in inches.

For example, assume the length of a vessel as 80 ft.:

$$\begin{aligned}\text{Mean sheer} &= \frac{80}{10} + 10 \\ &= 8 + 10 = 18 \text{ in.} \\ \text{Forward sheer} &= 18 \times 2 \times \frac{2}{3} \\ &= 24 \text{ in.} \\ \text{After sheer} &= 18 \times 2 \times \frac{1}{3} \\ &= 12 \text{ in.}\end{aligned}$$

Sheer Diagrams.—Given the rise, or height, at the extreme ends, due to sheer, the intermediate points can be found in various ways. A contracted sheer diagram is shown in Fig. 363, and

can be drawn by setting out the distance between the perpendiculars, and dividing this distance into any number of equal parts on each side of the lowest point; eight has been selected in the diagram shown. Erect perpendiculars, equal to forward sheer and after sheer, at *AB* and *CD*. Draw a line *BC* and produce to *O*. On *AB* draw a quadrant; divide this into eight equal parts, and draw horizontals from the points to intersect *AB*, and then join to *O*. Where these lines intersect perpendiculars drawn on *1, 2, 3, 4,* etc., will give points on the curve. Then draw a fair curve through the points thus found.

Another method is to calculate the heights on the centre ordinate *Ot*:

$$\text{Height } OM = \frac{O1^2 \times Ot}{OA^2} = \frac{5^2 \times 2}{40^2}$$

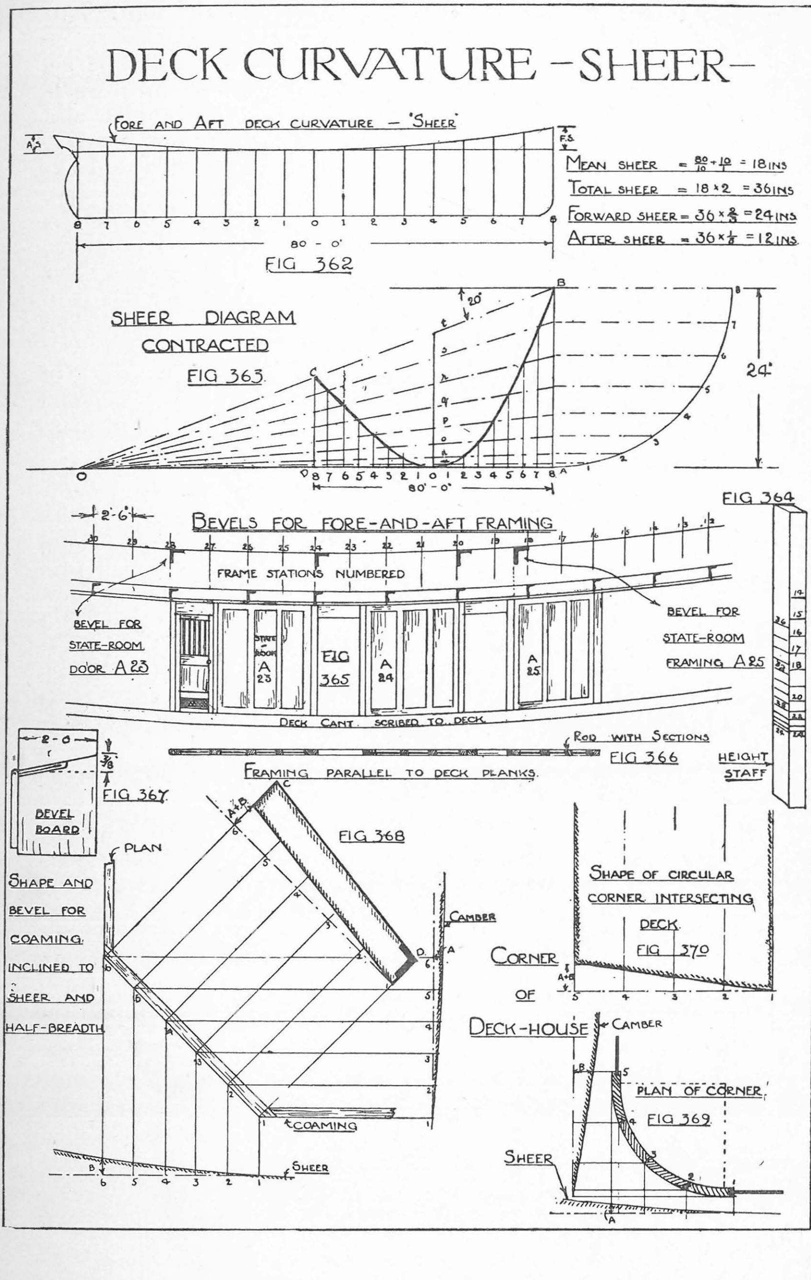
$$= \frac{50}{1600} \quad = \frac{50}{1600} \times \frac{12}{1} = \frac{3}{8} \text{ in.}$$

Draw the centre ordinate and set up the height, $\frac{3}{8}$ in., thus found. From *0* draw radiating lines through *m, n, o, p,* etc.; and where the perpendiculars from *1, 2, 3,* etc. meet the radiating lines, will be points on the curve. The distance *DO* equals *BO*.

Bevels.—In taking the fore-and-aft bevels, a height staff is used; and on this staff is marked the heights of the deck at the different frame spacings. These heights can easily be taken from the scrieve board and cut into the height staff. By a thoughtful use of this staff many of the bevels can be easily obtained. To take a concrete example: we find from the plan the position of the frame for the state-room *A25*, also the number of frame spacings in which this framing is situated, that is, Nos. 18 and 16. On the height staff, measure the difference in height from 18 to 16, which is, say, $\frac{3}{4}$ in. Taking the frame spacings to be 2 ft. 6 in., then the slope would be $\frac{3}{4}$ in. in 5 ft.

Now turn to the *bevel board*, Fig. 367. This board is made to suit a frame spacing, namely 2 ft. 6 in.; and to obtain the bevel over two frames, divide the height by 2, which would be $\frac{3}{4} \div 2 = \frac{3}{8}$ in. Square a line across the bevel board, set up $\frac{3}{8}$ in., and set the bevel as shown, thus obtaining the slope required.

Furniture is often all made square and not on the bevel to follow the curvature of the decks; of course, this simplifies the work a good deal, but the sight lines and parallels often look very bad. Where the furniture is made square, wide top and bottom rails are provided to take the fitting, and the wider the rails, the less easily will the divergence of the lines be detected. Also, in cases where furniture is made square and the particular fitting


DECK CURVATURE -SHEER-
FORE AND AFT DECK CURVATURE — 'SHEER'
MEAN SHEER = 80/10 + 10/1 = 18 INS
TOTAL SHEER = 18 × 2 = 36 INS
FORWARD SHEER = 36 × 2/3 = 24 INS
AFTER SHEER = 36 × 1/3 = 12 INS
80 - 0'
FIG 362
SHEER DIAGRAM CONTRACTED
FIG 363
24"
80' - 0"
FIG 364
BEVELS FOR FORE-AND-AFT FRAMING
FRAME STATIONS NUMBERED
BEVEL FOR STATE-ROOM DOOR A 23
BEVEL FOR STATE-ROOM FRAMING A 25
FIG 365
DECK CANT SCRIBED TO DECK
ROD WITH SECTIONS
FIG 366
HEIGHT STAFF
FRAMING PARALLEL TO DECK PLANKS
FIG 367
BEVEL BOARD
FIG 368
PLAN
SHAPE AND BEVEL FOR COAMING INCLINED TO SHEER AND HALF-BREADTH
CAMBER
COAMING
SHEER
SHAPE OF CIRCULAR CORNER INTERSECTING DECK
FIG 370
CORNER OF DECK-HOUSE
PLAN OF CORNER
FIG 369

extends to the deck above, it is necessary to fit the top rail to the bevel or incline of the deck.

Fig. 368 shows the method of finding the true shape and bevels for a coaming which is *inclined* to both fore-and-aft and thwartship lines. This is done by taking an elevation in true view and finding the amount of "rise up" due to sheer and camber. The plan shows the coamings in position for the angle of a deck-house. Fore-and-aft and thwartship sections of the deck are also shown. Ordinates are projected from points *1, 2, 3,* etc. on the plan, to their respective positions on the deck sections, and also into the new elevation. The amount of rise due to sheer is then set up in elevation, and added to this is the amount of rise due to camber, taking point No. 1 as the lowest point. Then through the points found in elevation a fair curve is drawn; and parallel to this is added a line *CD* showing the depth of the coaming. Lines drawn perpendicular to the plan at each end completes the shape, from which the bevel can also be taken as shown.

Round Corners.—Fig. 369 shows how to find the true shape of a round corner as seen in a deck-house. The plan of the corner is given as being built up in four sections. An ordinate is taken from each joint to the sheer and camber curves. The circular corner is then developed by stepping the length of quadrant, or plan curve, on to a straight line, as *1, 2, 3, 4, 5.* Taking *1* as the lowest point, the amount of rise on the deck is then set up the ordinates in the development, and a fair curve is drawn through the points thus found.

The lower portion would also be the shape of a development of the face of a coaming for a circular corner, and a template cut from same could be folded round the coaming to get a vertical joint.

The student may find some difficulty in understanding how to obtain a plumb-line—or a line perpendicular to the water-line: the steel ribs and stanchions are set plumb, and form a ready guide by setting work up parallel to them. It is usual, however, to have reference marks punched in the steelwork while the ship is on the stocks, so that the joiner can adjust an ordinary plumb-rule to them after the ship is launched. This adjustment is necessary, and will depend upon the position of the ship in the water.

CHAPTER IX

BULKHEAD FRAMINGS

IN this chapter, it is proposed to deal with framing other than saloon and other public room framing, the latter types being dealt with later. In large passenger ships, all the accommodation is partitioned off by means of framing and sheeting, so it will be understood what a large amount of this work is required, and how important it is that a joiner should fully understand its design and construction.

Simple Framing. — The piece of frame shown in elevation in Fig. 371 is suitable for a passage way, and would be extended in a fore-and-aft direction. It is plain and simple in design and, as in most work of this kind, the moulding is *stopped* about $\frac{3}{4}$ in. from the joint : thus the ends of the rails and muntins have square shoulders and require no scribing or mitring of the moulds. This stopping of the moulds is very characteristic of ship work ; as nearly all the joints are on the bevel, the difficulties of dealing with a mould in addition would considerably increase the work of setting out and fitting. Hence, with the exception of good class state-rooms and public rooms, it is quite common to find all mouldings stopped short of the joint. Before starting to make the frame, it is the common practice to lay the *cants* on the deck. The cant is usually of pitchpine or teak, and is rebated to receive the framing, a section of which is shown in Fig. 372. Of course, prior to fixing the cant, the position is lined off with a chalk line and square, as indicated on the plans.

The *runners* are next fixed in position. These form the structural part of the cornice and are grooved to receive the framing. It will be noticed that the groove is not in the centre of the runner ; this is to allow for the different thickness of the door standard, which is set centrally on the runner, and then allowance is made for cornice moulding. This only applies to the runners into which are fitted door standards ; many thwartship bulkheads have no door frames and then the size of runner can be reduced, as shown in Fig. 373. In completing the runner to form a cornice, one or more members of the moulding can be stuck on the solid, a scotia being used in the present example.

Inside the state-rooms a *filling piece* is used to make out the thickness of the framing to the same as that of the door frame, and so make the cornice mould continuous. The cornice mould is often hollowed out to cover up electric wires and is fixed after

the wires are in position. To complete the cornice, a nosing piece is planted on the runner; see section, Fig. 372.

In most cases the framing is mortised and tenoned together, but latterly *dowelling* has come largely into use. There is much to be said for both these methods, and one point not to be overlooked in favour of dowelling is the efficiency of the modern machine, which can bore as many as twelve holes at once and can be set to any desired distance. Dowelling saves a considerable amount of material as compared with making long tenons. However, in most yards mortising is still adhered to. It is very necessary to have strong framing on account of the strain to which the frame is subjected when the ship is rolling. This point cannot be emphasised too strongly, because there is nothing so annoying to the travelling public as to be kept awake at night by the constant squeaking of the loose panels and broken joints. It is a common practice to place flannel between the framing and its supports, and thus deaden the noise. In the case of *stub tenons* in framing, that is, tenons which cannot be wedged, screws are inserted from the inside, especially when the heads can be hidden, as under beds, etc. All other tenons are wedged and glued. The moulding on the frame shown is very suitable, being formed by a fillet and scotia; it can be stopped by the spindle and only requires to be cleaned with glasspaper.

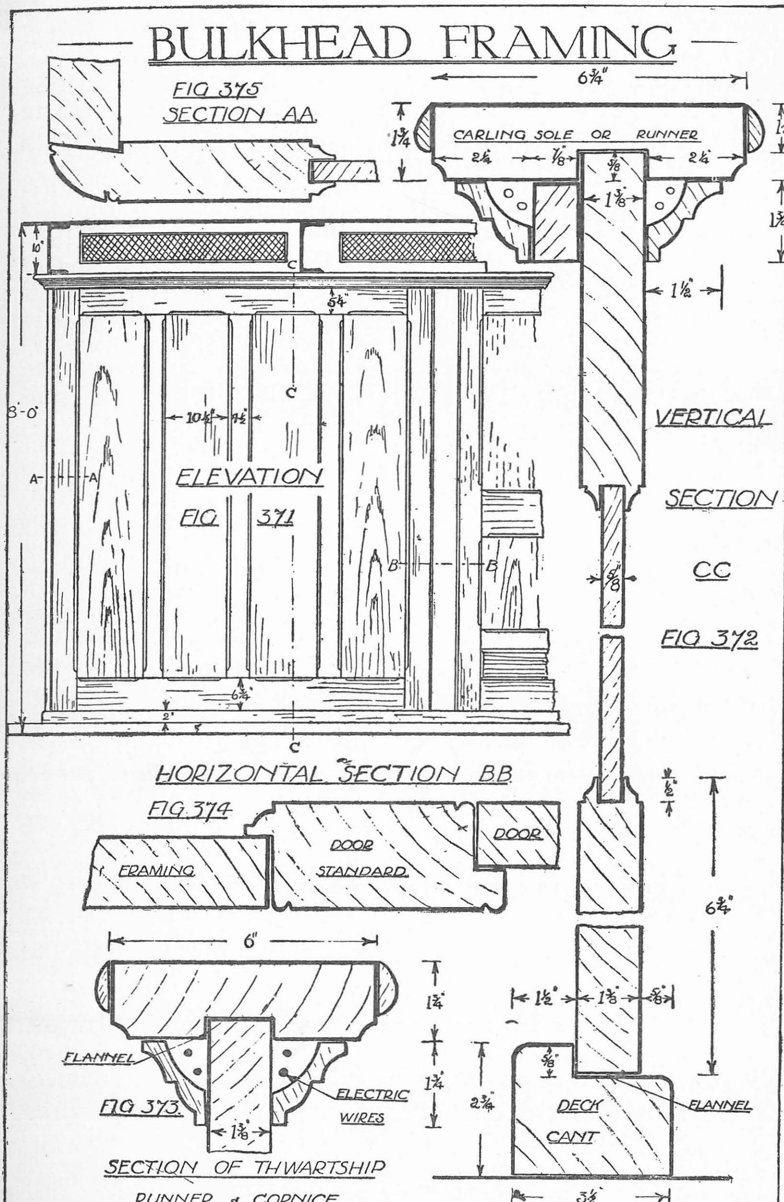
Section *AA*, Fig. 375, shows the method of finishing and jointing a *returned end* of a piece of framing. The corner is rounded and finished with two beads, and is fixed by nailing or *pocket screwing* from the inside.

Framing with Panelling on one Side and Sheeting on the Other.—This type of framing is quite common, especially where the *interior* of state-rooms is finished with tongued-and-grooved sheeting and the whole of the room requires to be finished in the same manner, while the passage is to be finished by panelling, often with pilasters and imitation arches.

The two elevations, Figs. 376 and 377, show the arrangement of this type of frame. The upper portion is fitted with *borrowed lights*, that is, the light from the port-hole is utilised to assist in lighting a passage or alleyway. An opening is left in the main framework, into which rebated linings are fixed to receive the sash, which is hinged at the bottom and opens against small side brackets having brass stops; see section *BB*, Fig. 378.

Section *AA*, Fig. 379, shows the method of dealing with the double thickness, that is, panel and sheeting. The frame stile is rebated and moulded in the ordinary way and the panel, which is often of *five-ply* wood, is fitted into the rebate and nailed. The sheeting is then fitted and nailed at the top and the bottom.

In the main framing, the muntins are not so thick as the


BULKHEAD FRAMING
FIG 375
SECTION AA
6¾"
CARLING SOLE OR RUNNER
1¾
1⅛
2¼
⅞
⅝
1⅜
1¾
1½
10"
C
5¼
C
8'-0"
10½"
1½
A
A
ELEVATION
FIG 371
B
B
VERTICAL
SECTION
CC
FIG 372
⅝
6¾
2"
C
HORIZONTAL SECTION BB
FIG 374
DOOR
DOOR STANDARD
FRAMING
½"
6¾"
6"
1¾
1¾
FLANNEL
ELECTRIC WIRES
FIG 373
1⅜
1½
1⅜
⅝
⅝
2¾
DECK CANT
FLANNEL
3½
SECTION OF THWARTSHIP
RUNNER & CORNICE

rails and stiles, being less by the thickness of the sheeting, thus allowing the sheeting to be continuous on the inside of the frame. The jointing, stopping of rebate, etc., is shown in Fig. 380. It is very common in ship work to lend variety to plain sheeting by putting in different coloured woods, for example, alternate boards of teak and pitchpine, or alternate boards of mahogany and sycamore, which give a very pleasing contrast in colour.

The lower portion of the frame is fitted with louvres for ventilation. The main ventilation for accommodation compartments is usually discharged along the passage ways; therefore, the fore-and-aft frames require openings to allow of the circulation of air into the state-rooms. These openings are effected in various ways; in some cases, the whole of the panels are formed of jalousies, and in others louvres are formed at the base of the framing and doors, as shown in the example under consideration.

Although for purposes of ventilation a large number of openings are essential, it makes the bulkhead very much less sound-proof, thus giving less privacy to the occupants of the various rooms.

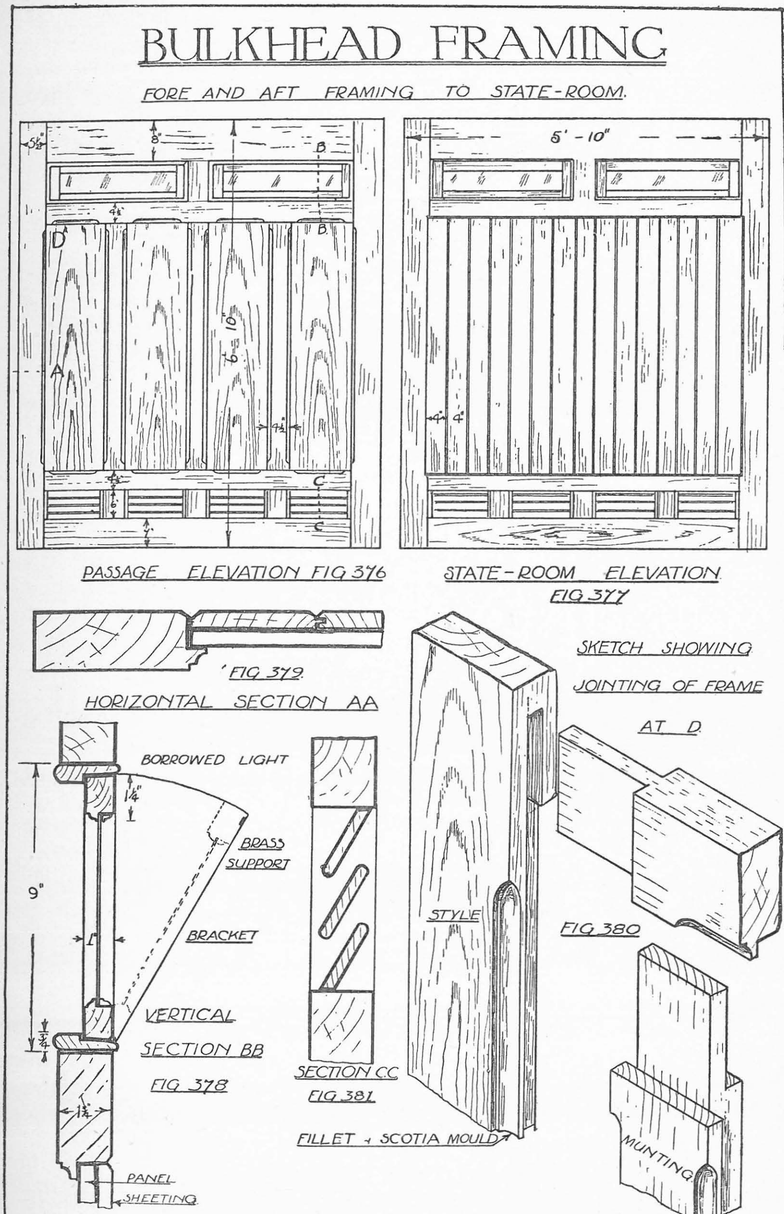
These louvre frames are often made separately and fitted when the whole is completed; but in the case shown a couple of vertical beads are slotted to receive the ends of the louvres, which are fitted and nailed in position. A vertical section is shown in Fig. 381, where three louvres are used, being bevelled to fit against the two rails.

Joints in Cants and Runners.—Figs. 382 to 396 illustrate the various joints used in cants and runners. Fig. 382 shows the joint at the *returned end* of a runner. The lower half is mitred and the upper half is lapped, the joint being known as a mitred and halved joint. In this joint a proper intersection of the members is obtained on the under side, and a means of screwing together is obtained by halving. The end wood of the halved joint is covered by a nosing—usually planted on. In Fig. 382 is also shown the section of the runner, and Fig. 383 is a sketch of one piece forming the joint.

Fig. 384 shows the joint where two runners intersect at right angles to one another. In this case, the moulding is mitred and the straight part is halved; by this method a *continuous groove* is obtained. Fig. 385 is a sketch of one piece.

Fig. 386 illustrates the lengthening of a runner. In many cases, a fore-and-aft runner is 200 ft. long and has to be jointed, the maximum length of scantling being often not more than 20 ft. A *scarf joint* is used, as shown, and should not be too short—say about 6 in., and four screws should be used.

Figs. 388 to 390 give three different methods of fixing the *top runner* to the deck beams. The joint on one length of runner is prepared, and the length is then held temporarily in position


BULKHEAD FRAMING
FORE AND AFT FRAMING TO STATE-ROOM.
5' - 10"
6' 10"
PASSAGE ELEVATION FIG 376
STATE-ROOM ELEVATION FIG 377
FIG 379
HORIZONTAL SECTION AA
SKETCH SHOWING JOINTING OF FRAME AT D
BORROWED LIGHT
BRASS SUPPORT
BRACKET
9"
VERTICAL SECTION BB FIG 378
SECTION CC FIG 381
STYLE
FIG 380
FILLET & SCOTIA MOULD
MUNTING
PANEL
SHEETING

by a prop and plumbed up from the cant. The first method—that of fixing to the deck beam by a *lug* and *bolts*—is very common. Secondly, a *tap screw* is sometimes used; while the runner is held in position the driller bores and taps a hole into the bulb, and a set screw is inserted. The third method is to cut a *tapered* and *wedge-shaped* groove into the runner, and to drive in a *dovetail key*, as shown in edge view, Fig. 390. These three examples are only for runners extended fore and aft.

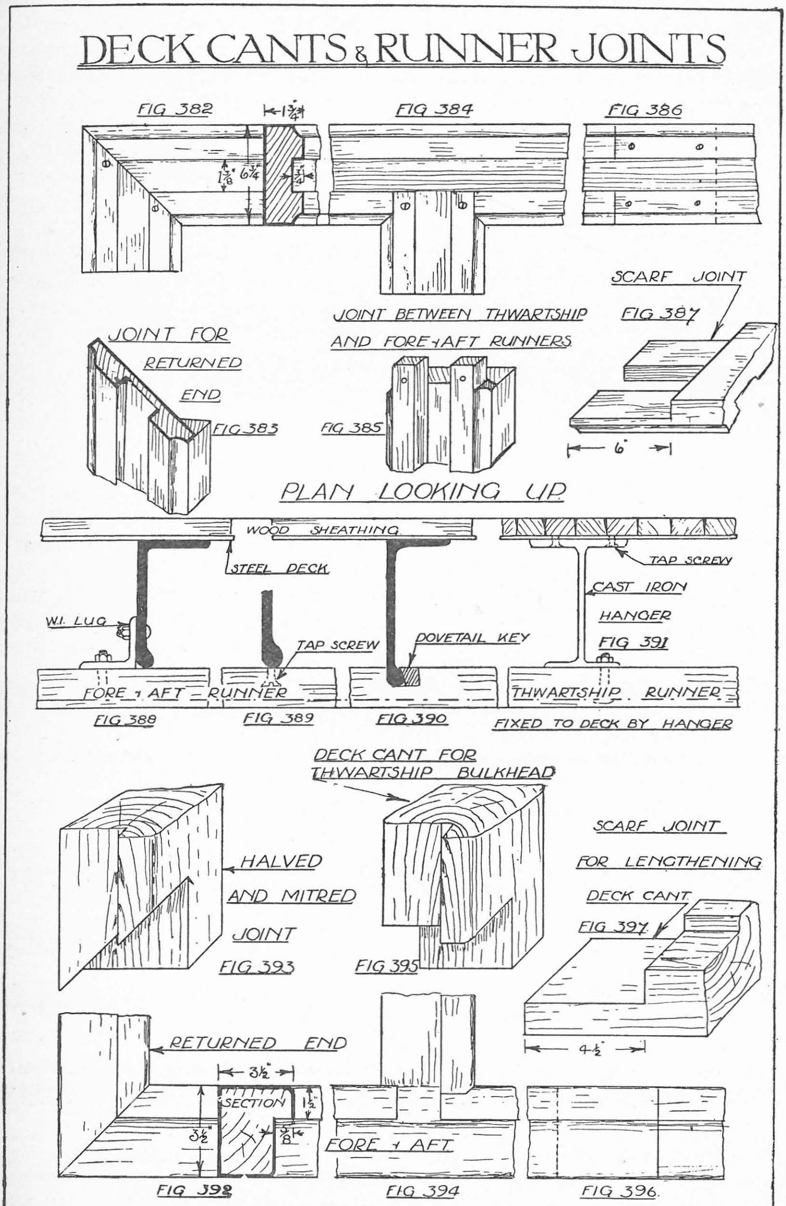
Fig. 391 shows a method of fixing a *thwartship runner* to the steel deck-plating by means of a cast-iron or steel *hanger*. The upper end is fixed by tap screws, and the runner is bolted to the lower end. The depth of the hanger is the same as the deck beams; and, of course, where the position of the thwartship runner coincides with the deck beam it could be fixed by lugs, as for a fore-and-aft runner.

Figs. 392 and 393 show the section and *angle joint* for a deck cant; it is halved and mitred, and nailed. These joints should be painted before fixing. Figs. 394 and 395 show the joint between a fore-and-aft and thwartship cant, arranged to give a continuous rebate for the framing, and Figs. 396 and 397 show the method of lengthening a deck cant by scarfing.

Deck cants are usually scribed and nailed down on top of a wooden deck, the joint being made by lead paint; but where a composition deck such as "*lito-silo*" is used, the deck cant can be fixed much in the same way as to wood, by nailing to the composition. Also, in some cases, the framing is kept above the deck, especially where there is much moisture, as in lavatories, etc.; in such cases, a steel angle piece is carried up and the cant is bolted to the side of it, the cant in turn carrying the framing.

Ceilings and Casing of Deck Beams.—This part of the subject might have been dealt with under the head of saloon panelling and finishing of public rooms, but a good deal of it is required in the state-rooms and accommodation, and it has therefore been included here. It often happens in state-room accommodation that the deck beams are left without any wood casing, in which case the beams are painted, and while the last coat is wet it is given a good sprinkling of granulated cork. The reason for this is that the cork absorbs the condensed moisture so much in evidence on the steelwork in a ship.

Simple Methods: Fig. 398 is a section showing probably the simplest method of *encasing* a deck beam in wood. The two *beam sides* are fixed by screwing one to the other, the screws being arranged to pass through holes previously drilled in the beam. The *beam sole* is then screwed up to the beam sides; a mould is run on the two edges of the beam sole; and there is no wooden ceiling shown in this case. Probably the next simplest method is shown in Fig. 399, also without wooden ceiling.


DECK CANTS & RUNNER JOINTS
FIG 382
1¾"
1⅞"
6¾"
¾"
FIG 384
FIG 386
SCARF JOINT
FIG 387
JOINT BETWEEN THWARTSHIP
AND FORE & AFT RUNNERS
JOINT FOR
RETURNED
END
FIG 383
FIG 385
6"
PLAN LOOKING UP
WOOD SHEATHING
STEEL DECK
TAP SCREW
CAST IRON
HANGER
FIG 391
W.I. LUG
TAP SCREW
DOVETAIL KEY
FORE & AFT RUNNER
THWARTSHIP RUNNER
FIG 388
FIG 389
FIG 390
FIXED TO DECK BY HANGER
DECK CANT FOR
THWARTSHIP BULKHEAD
HALVED
AND MITRED
JOINT
FIG 393
FIG 395
SCARF JOINT
FOR LENGTHENING
DECK CANT
FIG 397
4½"
RETURNED END
3½"
SECTION
1½"
3½"
⅞"
FORE & AFT
FIG 392
FIG 394
FIG 396

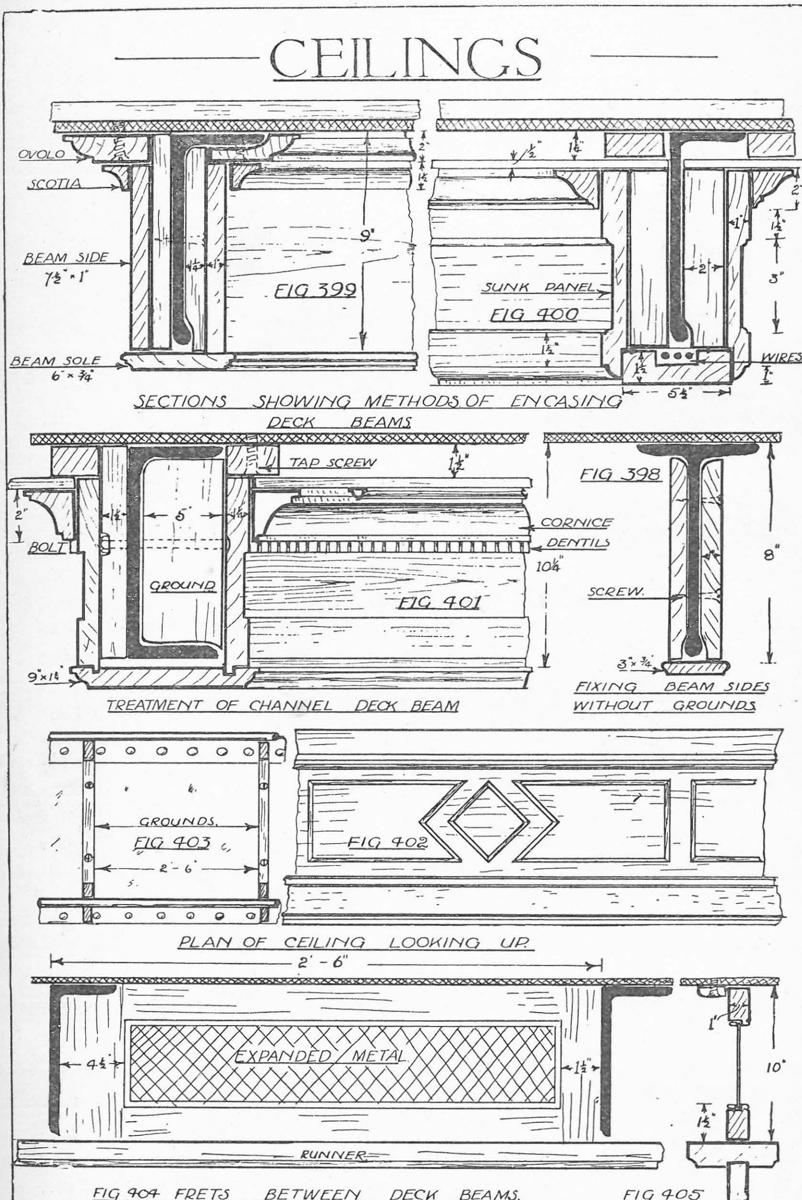
Two grounds, $1\frac{1}{4}$ in. square, are fixed to the *web* of the beam by screwing through it. An ovolo moulded piece is then tap screwed to cover the rivets and flange of the beam—this will be clearly seen in the section. The beam sides and sole are then fixed to the grounds by nailing, and a scotia planted under the ovolo mould forms a pleasing and effective finish to the casing. In lengthening the beam sides and sole, it is usual to splay and joint them over a ground. The beam sides will, of course, follow the camber of the deck, and require to have a good curve to which the beam sole can be fitted.

Casing Beam with Wood Ceiling: Fig. 400 shows a section and elevation of a casing to a beam where there is a wood ceiling. Grounds 3 in. by $1\frac{1}{4}$ in. are tap screwed to the steel deck; thwartship grounds run the full length of the deck beam and the fore-and-aft grounds are spaced about every 2 ft. 6 in. The ceiling proper is of "five-ply." This kind of wood is very suitable, as it is easily bent to the flat curve of the deck. It is ornamented by planting mouldings of a design such as is shown in plan looking up, Fig. 402. The beam sides have a *sunk panel* and imitation muntins planted on the face, with cornice mould to finish the meeting of the beam sides and ceiling. The beam sole in this case is fitted between the sides, and is often grooved to receive electric wires, as shown.

Casing to Channel Iron: Fig. 401 shows a more elaborate example of finishing, a *channel iron* deck beam being used, as in the case of a dining saloon or other public room. In this example, the grounds, being wide, are bolted through; and the whole casing is finished in good style for polished work.

Ventilating Frets: It is usual to fill in the space between the top runner and the deck plating with ventilating frets. These frets form an extra means of ventilation, and give an ornamental finish, between the deck beams. They are mortised and tenoned together at the angles, and a wider fitting stile is left on the flange side of the beam. The panel can be of either *expanded metal* or a *cast-iron grille* of ornamental pattern held in by beads. The lower rail is nailed to the top runner, while a fillet to which the *upper rail* is fastened is fixed to the deck above. This will be seen clearly in elevation and section, Figs. 404 and 405. The space between a thwartship runner and the deck is often filled in with a solid board, and sometimes fitted with a *torpedo shutter ventilator*. It is not uncommon to leave these spaces above the runner entirely open; but this method, while excellent for purposes of ventilation, robs the state-rooms of a good deal of their privacy.

Door Frames.—Door frames require to be thicker than the ordinary framing, and are composed of two standards and a head. The *standards* are rebated on both edges, one rebate to


CEILINGS
OVOLO
SCOTIA
BEAM SIDE
7½" × 1"
BEAM SOLE
6" × ¾"
9"
FIG 399
SUNK PANEL
FIG 400
WIRES
5½"
SECTIONS SHOWING METHODS OF ENCASING DECK BEAMS
TAP SCREW
CORNICE
DENTILS
10¼"
BOLT
GROUND
FIG 401
9" × 1½"
TREATMENT OF CHANNEL DECK BEAM
FIG 398
SCREW.
8"
3" × ¾"
FIXING BEAM SIDES WITHOUT GROUNDS
GROUNDS.
FIG 403
2'-6"
FIG 402
PLAN OF CEILING LOOKING UP.
2'-6"
EXPANDED METAL
4½"
1½"
RUNNER
10"
FIG 404 FRETS BETWEEN DECK BEAMS.
FIG 405

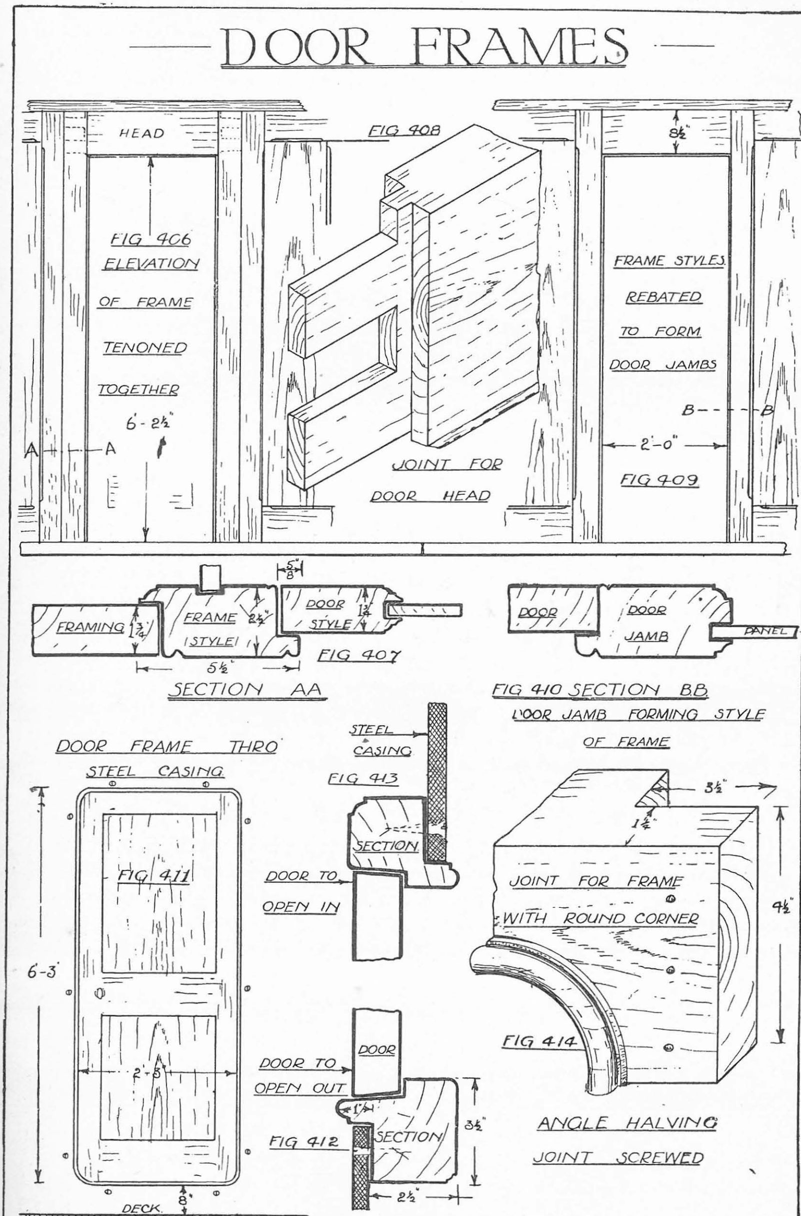
receive the door and the other for the framing. The frame shown in Figs. 406 and 407 has the head tenoned to the standard, as in Fig. 408. These frames can be made in the shop to the required size. There are no standard sizes for doors in the ship, but a very common width for state-room doors is 2 ft. 1 in—to show 2 ft. between the standards and allow $\frac{1}{2}$ in. for the rebate at each side. The top of the frame is rebated on the inside to fit in the groove in the runner.

An alternative method is often employed which results in a saving of material and time. This method is to frame the door standards on the ordinary bulkhead framings; they then act in the double capacity of door standards and frame stiles. The inside edge of the door standard is rebated to receive the door, and the *opposite* edge is grooved to receive the panel. Fig. 409 shows the elevation, and Fig. 410 is a section at *BB*. The door frame head is sent loose to the ship; it is fitted into the rebates of the standards and nailed in position. After the door frame is fixed, the raised part on the deck cant is cut away between the standards, thus leaving a level step. In some cases, this is covered with a *brass plate* to prevent excessive wear of the wood.

Steel Casings: Many doors, such as into lavatories and steel deck-houses, open through *steel casings.* The frames for these require different treatment, as shown in Figs. 411 to 414. The frame is composed of two standards, head, and sill, and must be made to suit the size of opening cut in the steel casing. Most of these openings follow the camber of the deck, and have *rounded corners.* Round corners are frequently met with in cuttings through steel plating. Most of these casings have to withstand considerable strain, and it was found that square corners were a source of weakness; hence the round corners are invariably adopted. The frame illustrated is for a door to open outwards. A bead and fillet breaks the joint between the frame and the steel. The four pieces of frame are made to section, as shown in Fig. 412, and extra material has to be allowed on the rail and sill to work the round corner, the joint for which is shown in Fig. 414. The joint is screwed and painted, and the frame is held to the steelwork by stout wood screws or bolts.

The rebates to which the door closes should be covered with *thick felt.* This prevents the door from rattling, and also assists in making it more watertight. Most exposed doors open to the outside, but where the door requires to open to the *inside,* a section of material as shown in Fig. 413 is adopted.

State-room Door.—The door shown in Figs. 415 to 421 is a typical design, and one which is very largely used. It has three panels, and the bottom one is fitted with a louvre frame for ventilation. The frame is made up of two stiles, $4\frac{3}{4}$ in. by $1\frac{1}{2}$ in., top rail, $4\frac{3}{4}$ in. by $1\frac{1}{2}$ in., lock rail, 9 in. wide, louvre rail, $4\frac{1}{4}$ in.,


DOOR FRAMES
HEAD
FIG 406
ELEVATION
OF FRAME
TENONED
TOGETHER
6'-2½"
A
A
FIG 408
JOINT FOR
DOOR HEAD
8½"
FRAME STYLES
REBATED
TO FORM
DOOR JAMBS
B
B
2'-0"
FIG 409
5/8"
FRAMING
1¾"
FRAME
(STYLE)
2¼"
DOOR
STYLE
1¾"
5½"
FIG 407
SECTION AA
DOOR
DOOR
JAMB
PANEL
FIG 410 SECTION BB
DOOR JAMB FORMING STYLE
OF FRAME
DOOR FRAME THRO
STEEL CASING
FIG 411
6'-3"
2'-3"
DECK
8"
STEEL
CASING
FIG 413
SECTION
DOOR TO
OPEN IN
DOOR
DOOR TO
OPEN OUT
1"
FIG 412
SECTION
3½"
2½"
3½"
1¼"
JOINT FOR FRAME
WITH ROUND CORNER
4½"
FIG 414
ANGLE HALVING
JOINT SCREWED

and bottom rail, $7\frac{1}{4}$ in. wide. The height of these doors varies to suit the framing, but should not be less than 6 ft. 1 in.; a very common width is 2 ft. 1 in. The position of lock rail is determined by the height of door knob, which is 3 ft. 3 in. from the bottom of the door, or 3 ft. 6 in. from deck level—allowing 3 in. for depth of cant. It will be noticed that the stiles, top rail, and louvre rail will all show the same width on the passage side of the door, assuming a rebate of $\frac{1}{2}$ in. all round; and the lock rail and bottom rail are increased in width to give extra strength.

The door is framed together by mortise and tenon joints, details of which are shown. Fig. 418 shows the joint between the top rail and the stile. Fig. 419 shows the joint between the lock rail and stile; the tenons in this case should be kept such a distance apart that a *mortise lock* will not cut away the wedges or part of the tenon, or the joint will be weakened. Fig. 420 shows the jointing of the louvre frame.

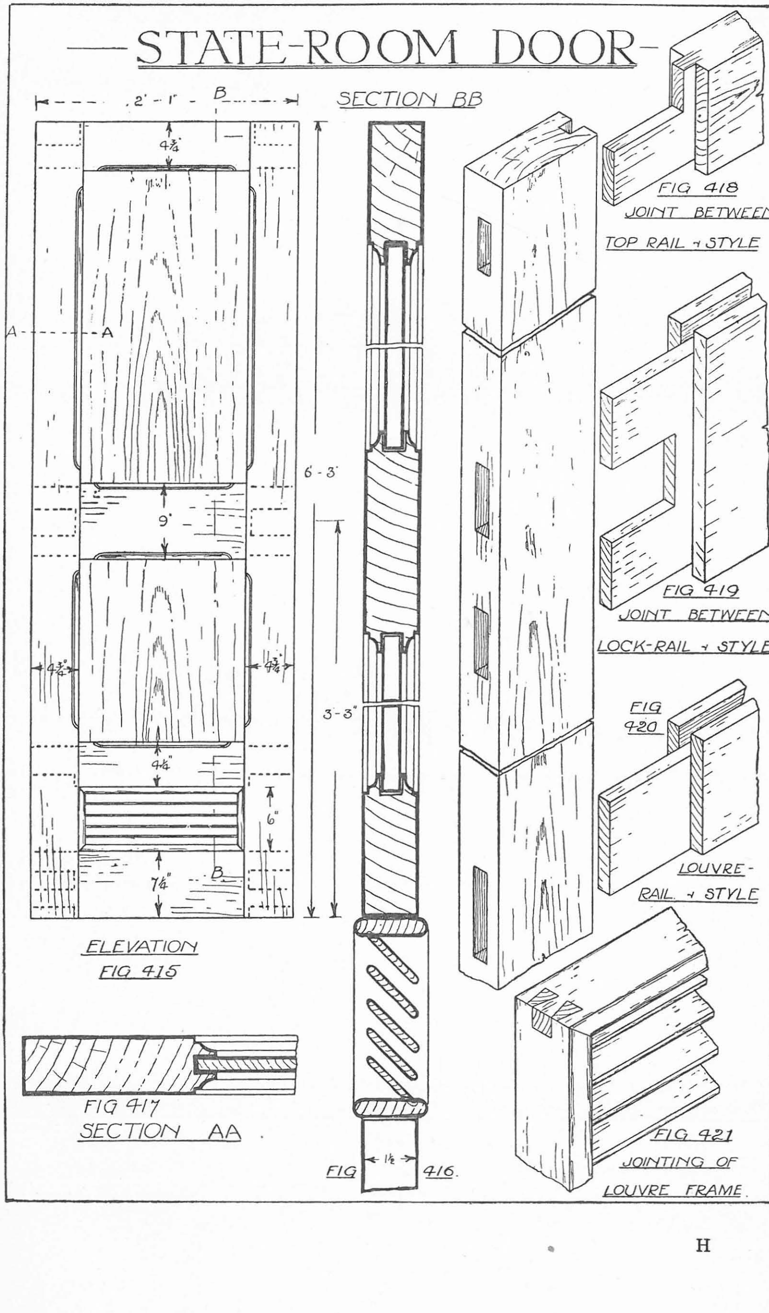
The angles are dovetailed, and the rounded edges are mitred. The beads of which this frame is formed often project beyond the face of the frame, as seen in vertical section, Fig. 416. This frame is made up separately from the door, and is fitted in after the latter is complete, being nailed in position. The vertical beads are slotted to receive the ends of the louvres, which are inclined at an angle of 60°, and should slope so as to diffuse the air into the state-room, that is, upwards from the passage side.

The door is moulded on both sides, and the mouldings are shown *stopped* $\frac{3}{4}$ in. from the joints. The frame is grooved, to a depth of $\frac{1}{2}$ in., as shown in section *AA*, Fig. 417, to receive the panels.

Method of Making Door: While a good many of these doors may be of standard design and size, it must be remembered that they will all be different as far as the *bevel* is concerned with the exception, of course, that similar doors at port side, and starboard side, will have the same bevel. This means that each door will have to be "set out" separately, before being sent to the machines. A *height rod*, showing the positions of the tenons, will be prepared, and these positions are marked on the face of one stile; the stiles are then placed together, face sides up, and the mortises marked with the bevel across the face of the two stiles. The lines are then squared across the edges, allowance being made on the outside for wedges.

To find the size of tenons, a good rule is to make the thickness one-third that of the frame, and the width of a tenon should not exceed five times its thickness.

The *four rails* of the door can be marked in the same way, with a large bevel, by placing them all together face sides up and in their proper relative positions. It may be necessary to hold them together by a cramp at each end, and then the lines



ELEVATION FIG 415

FIG 416.

FIG 417 SECTION AA

FIG 418 JOINT BETWEEN TOP RAIL + STYLE

FIG 419 JOINT BETWEEN LOCK-RAIL + STYLE

FIG 420 LOUVRE-RAIL + STYLE

FIG 421 JOINTING OF LOUVRE FRAME.

can be marked right across by a scriber. The lines are squared across the edges, and while in the cramps the under-side shoulder lines can be drawn in. The whole of the joints can now be gauged, and the stuff is then ready for the machines.

After *machining*, the edges are ploughed for the panels. The pieces are fitted together, and then sent to the *spindle* for moulding. Lastly, the panels are fitted, and the door is ready for gluing.

Types of Cabin Doors.—In a large passenger liner, hundreds of cabin doors are required, and many and varied are the designs adopted. The two chief features which modify the design are: the arrangement for ventilation; and the design of the general framing of which the door forms a part, and to which the general outline and decorative features of the door must conform.

On the accompanying sheet are shown five different types of cabin doors. Fig. 422 is an ordinary two-panel door with an additional bottom panel of expanded metal for ventilation. The metal is usually painted a similar colour to the door, and is held in position by beads. Sometimes a cast-iron grid is used instead of the expanded metal, the grid allowing of greater variety in design; very often interwoven in the design is the shipping company's monogram or trade-mark.

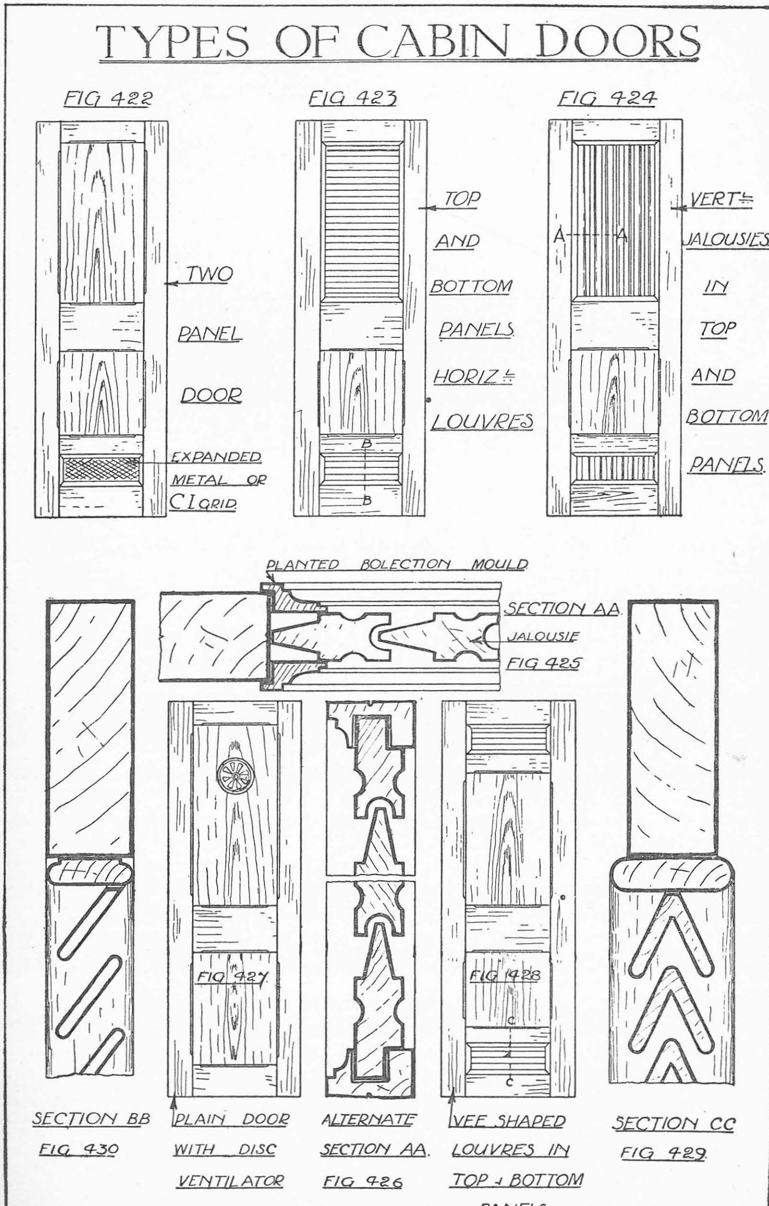
Fig. 423 shows a door with the top and bottom panels of ordinary louvres. In this type of door the louvres are often housed into the door stile, and no separate frame is required, the beads being stuck on the solid. A section through *BB* is shown in Fig. 430.

The next type of door, Fig. 424, has jalousie panels at the top and the bottom, the jalousies being vertical. Section *AA*, Fig. 425, shows a section of the jalousie adopted; the ends of the top panel are tenoned into the top rail and the lock rail of the door, and a small bolection mould is carried around the panel.

An alternative method of fitting the jalousies is shown in Fig. 426, where they fit into a groove as in the case of a panel; the ends of the jalousies are rebated to fit into the same groove which is carried round the top and lock rails. A *stuck moulding* is worked on the face of the door, and the inside is left square.

Fig. 427 shows a plain door with disc ventilation. This type of door is often used in places where the door opens directly into the open; such as in officers' accommodation on the bridge. The disc ventilator can be opened or closed at will, and should be at a convenient height. The apertures are so arranged as to obstruct a direct view into the room.

A four-panel door is shown in Fig. 428; the top and bottom panels are fitted with V-shaped louvres, a section of which is shown in Fig. 429. This type of louvre diffuses the air and prevents draughts.


TYPES OF CABIN DOORS
FIG 422
TWO PANEL DOOR
EXPANDED METAL OR CI GRID
FIG 423
TOP AND BOTTOM PANELS HORIZ^L LOUVRES
B
B
FIG 424
VERT^L JALOUSIES IN TOP AND BOTTOM PANELS
A
A
PLANTED BOLECTION MOULD
SECTION AA
JALOUSIE
FIG 425
FIG 427
FIG 428
C
C
SECTION BB
FIG 430
PLAIN DOOR WITH DISC VENTILATOR
ALTERNATE SECTION AA.
FIG 426
VEE SHAPED LOUVRES IN TOP + BOTTOM PANELS
SECTION CC
FIG 429

The *hardware* required for one of these doors includes one pair of 4-in. brass butt hinges; one mortice lock with furniture; one ajar hook for holding the door slightly ajar; one silent cabin hook for holding the door when open; and metal or mahogany finger plates.

Portable Bulkheads.—Space which is utilised for passenger accommodation on a voyage is often required for cargo on the return voyage, or *vice versa;* therefore it is necessary to have a ready and portable means of dividing the space into compartments or state-rooms, and portable bulkheads are required. There are several different arrangements and fittings to make the bulkheads portable, but owing to limited space it is only possible here to illustrate one system, this being shown in Figs. 431 to 443.

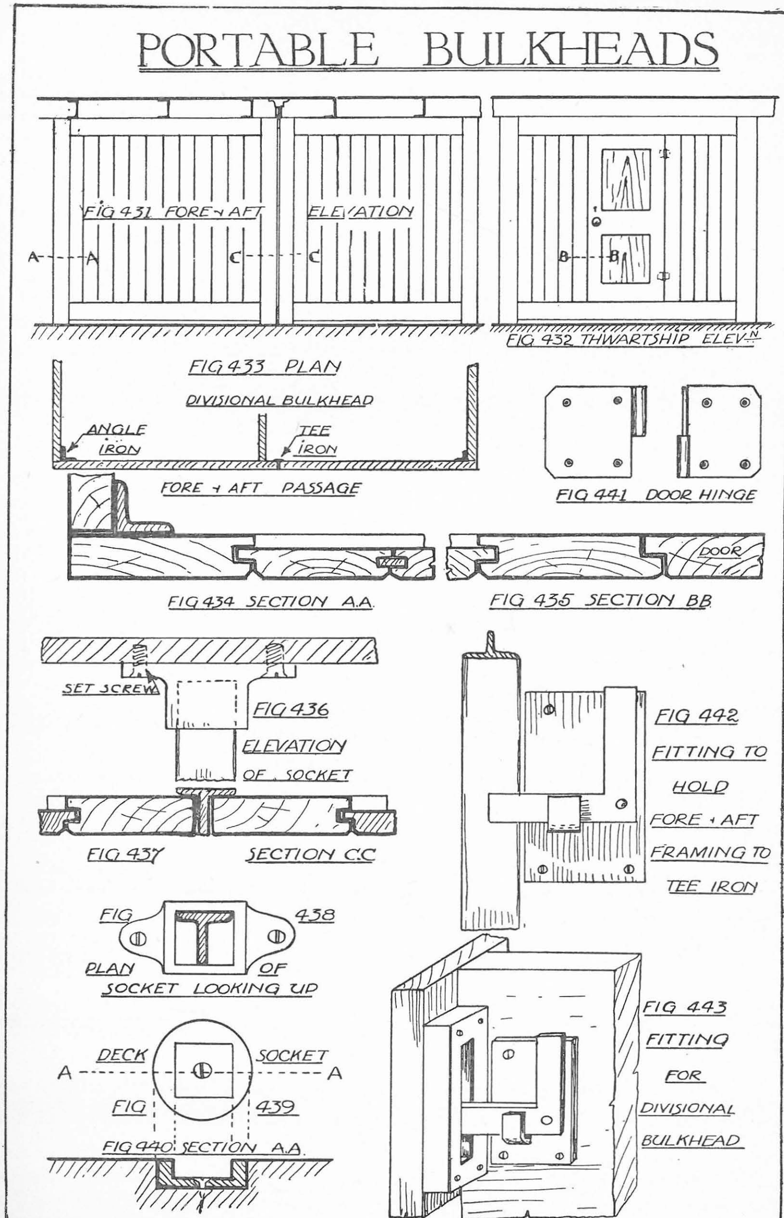
T and *angle irons,* $1\frac{1}{2}$ in. by $1\frac{1}{2}$ in., are used as standards at the junction of the different frame sections, and are fitted into sockets, one tap screwed to the deck above, and one sunk flush into the floor or deck. These sockets have square recesses, so that they will suit either angle or T-iron sections. The socket fixed at the top has a deep recess so that the standard may be entered into it first, and then dropped down into the deck socket. These details should be quite clear on reference to Figs. 436 and 439.

The general arrangement of the *frame section* is shown in the elevations and plan, Figs. 431 to 433. These sections fit close up to the channel-iron deck beams, and the doors are fitted into the thwartship frames. The space is left open between the deck beams, and the doors are made to lift off the hinges; a useful type of hinge is shown in Fig. 441. The stiles and rails are framed together, and the panel spaces filled in with *feather-and-groove sheeting,* as shown in Fig. 434. The frames are usually of yellow pine and not more than $1\frac{1}{4}$ in. thick, so as to be light for handling.

The frames are held in position against the standards by *wrought-iron fittings,* as shown in Figs. 442 and 443. The fitting is fixed to the frame sections; and a pivoted *angle-arm lever* turns over against the standard, thus keeping the framing tight in the rebate. In the case of a thwartship divisional bulkhead, the arm is turned into a slotted piece screwed to the fore-and-aft framing.

When stowing away these frames when not in use, it is important that they should not be jammed into any twisted positions, or a permanent *twist* might be given to the frames and make them difficult to fit.

Baths used in this type of convertible accommodation are usually of metal, and are arranged to fold up.


PORTABLE BULKHEADS
FIG 431 FORE & AFT ELEVATION
A A
C C
B B
FIG 432 THWARTSHIP ELEV.N
FIG 433 PLAN
DIVISIONAL BULKHEAD
ANGLE IRON
TEE IRON
FORE & AFT PASSAGE
FIG 441 DOOR HINGE
DOOR
FIG 434 SECTION A.A.
FIG 435 SECTION BB
SET SCREW
FIG 436
ELEVATION OF SOCKET
FIG 437
SECTION CC
FIG 442
FITTING TO HOLD FORE & AFT FRAMING TO TEE IRON
FIG 438
PLAN OF SOCKET LOOKING UP
DECK
SOCKET
A A
FIG 439
FIG 440 SECTION A.A.
FIG 443
FITTING FOR DIVISIONAL BULKHEAD

CHAPTER X

DECK LADDERS AND STAIRS

VARIETIES of Deck Ladders.—Deck ladders form the means of communication between one deck and another. When between exposed, or *weather*, decks they are made of teak or pitchpine, and are usually seen in the following positions :

Two between flying bridge or navigation bridge, *four* between navigating bridge and boat or shelter deck, *one* between flying bridge and compass platform, *one* to seamen's quarters in the forecastle, and *one* leading to accommodation in poop.

The last two are often in combination with a *companionway*, which is to provide a watertight shelter over the deck opening.

Ladders to the *engine-room* are practically always of steel, on account of the heat and moisture which would quickly set up decay in woodwork.

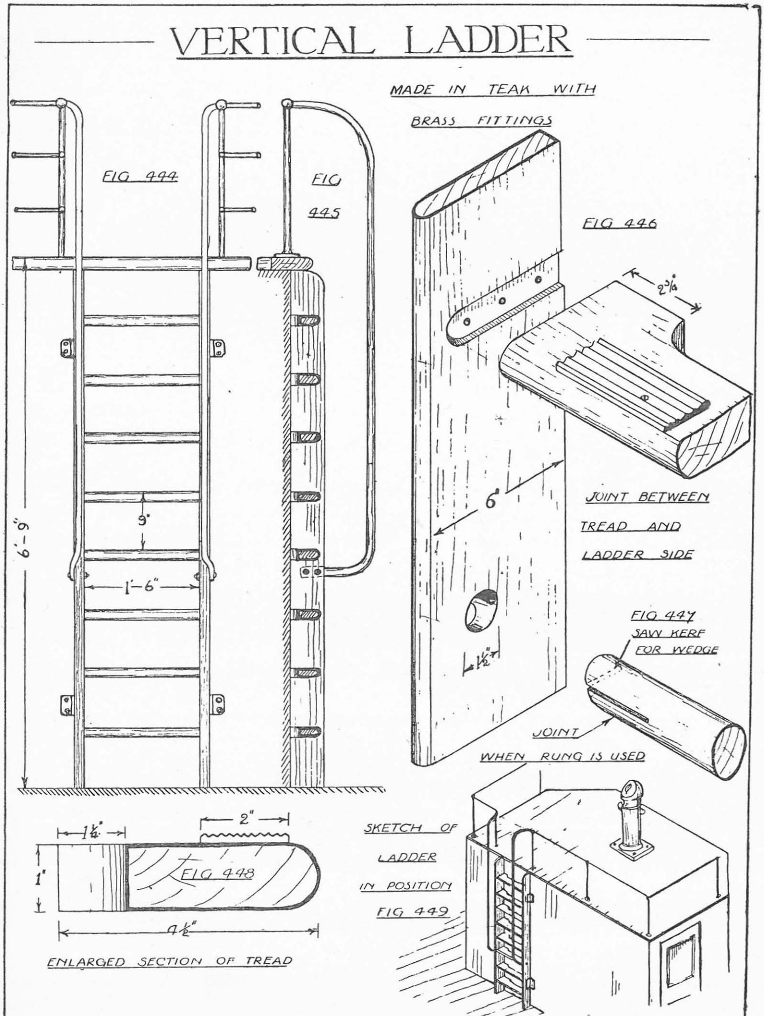
Ladders are made in various sizes, the *spread* being usually from 1 ft. 6 in. to 2 ft. 6 in. ; the *rise* to be comfortable should not be greater than 9 in. ; and the *slope* should be such that the angle between the ladder side and a plumb-line will not be less than 37°.

Where ladders are exposed steel handrails are used, or sometimes steel covered with rope ; but in the 'tween decks or sheltered positions wood handrails are adopted.

The accompanying drawing will illustrate clearly the construction and the usual dimensions.

Vertical Ladder.—Figs. 444 to 449 show a vertical ladder or, as it is sometimes called, a *Jacob's ladder*. It is fixed to a deck-house, and is usually seen leading to a compass platform. It has only one recommendation, that it requires a *very small amount of deck space ;* it should only be adopted in confined positions. The sides are of teak, and alternative forms of tread are shown, one form with a *rung* similar to an ordinary ladder, and the other with a *narrow tread*. The former is fixed by boring holes into the ladder side, inserting the rungs after coating with lead paint, and wedging. A saw kerf is cut in the end of the rung and should be placed perpendicular to the grain of the wood to prevent the splitting of the ladder side when the wedge is driven in; see Fig. 447. When treads are used, an opening is cut in the edge of the tread next to the casing to allow for the escape of water ; see Fig. 448. *Step guards* are fitted to the treads and are fixed by brass screws. These guards are used

extensively in connection with deck ladders and stairs. They serve the double purpose of preventing the wooden steps from wearing, and provide a rough surface, which prevents persons



using the ladder from slipping. Galvanised steel guards or brass ones are commonly used in exposed positions; lead has splendid qualities for resisting the weather, but it invariably becomes

slippery after being in use for a time. The ladders are fixed to the deck-house by means of lugs and bolts, as shown in Fig. 444; these also prevent the joints from opening and render through bolts unnecessary. The handrail is fixed to the ladder sides by bolting, and is carried up and fixed to the stanchions around the platform.

Fig. 449 is a sketch of the ladder in position, leading up to a compass platform.

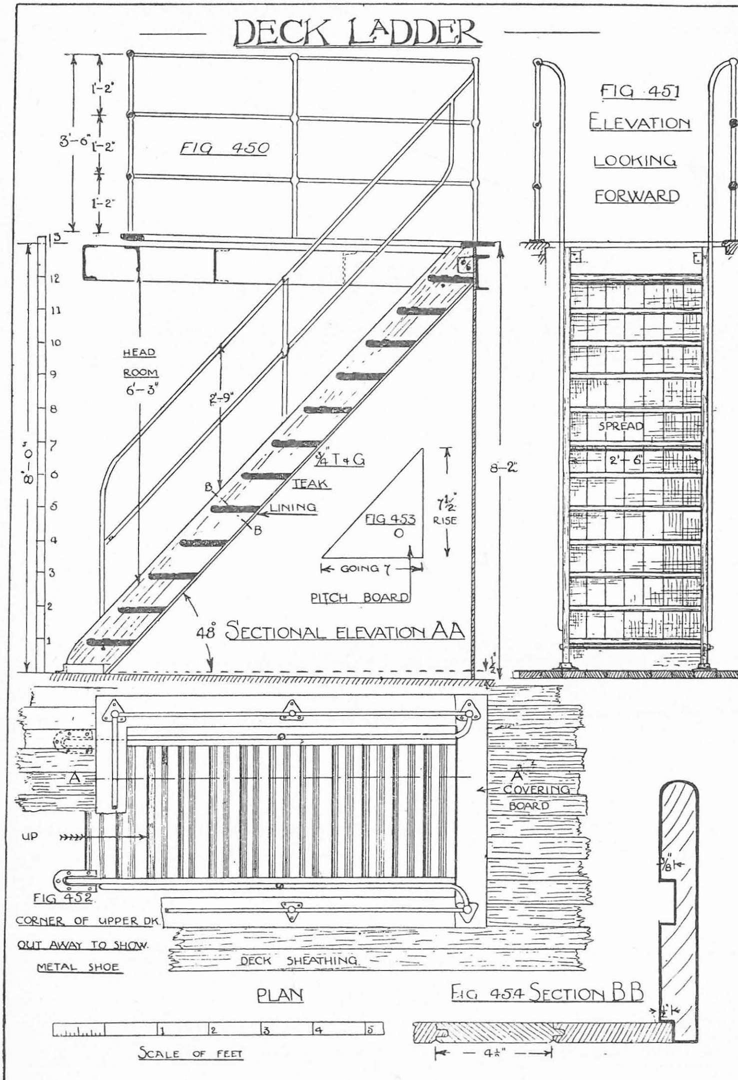
Sloping Deck Ladder.—This ladder is the usual type—*pitched* so as not to have an angle smaller than 37° with the vertical —the angle in the example shown in Figs. 450 to 454 being 42°. The ladder is 2 ft. 6 in. wide, and is fitted between decks 8 ft. apart. It has thirteen treads and, allowing for a 2-in. cover board and $\frac{1}{2}$ in. difference in height due to sheer, the *actual rise* from bottom to top of ladder would be 8 ft. $1\frac{1}{2}$ in.; and the *rise per tread* would then be 8 ft. $1\frac{1}{2}$ in., divided by 13, which is $7\frac{1}{2}$ in.

The well is formed by a fore-and-aft steel *carling* carrying the ends of two cut deck beams, and a bulb angle support is fitted to give the necessary headroom of 6 ft. 3 in., as shown in elevation, Fig. 450. The *cover board* is carried around the well, and allowed to project to form a rounded nosing. The cover boards are painted and butted at the angles, and screwed down in position. A steel rail is fitted around the well to prevent accidents, and a handrail is carried down each side of the stair, as shown in elevation, Fig. 450. There are no risers in this type of ladder, but the back should be close boarded, being usually tongued and grooved. If the ladder is used solely by men open boarding is sometimes adopted.

Construction: The ladder sides are 9 in. by $1\frac{1}{2}$ in., and are trenched to a depth of $\frac{1}{2}$ in. to receive the ends of the treads. The treads are rounded at the front edge, and bevelled at the back to receive the boarding, and are held in position by *nailing*. The nail heads are covered by wood plugs. In addition, three $\frac{1}{2}$-in. bolts are put right through the stairs, to prevent the sides coming apart. The ladder is held in position at the top by lugs bolted to the bulkhead and to the ladder sides; galvanised iron shoes are provided at the bottom, being pushed tight against the feet, and screwed down to the deck. While the actual "going" on the pitch board is 7 in., the tread is not stopped short, as when risers are used, but is carried back to the sheeting; this gives a broader wearing surface and a stronger tread.

The *treads* usually have some form of *step guards;* in some cases they are covered entirely by lead, which is grooved at the front edge; this, however, soon wears smooth. Lead has the advantage that it does not become slippery, as most metals. *Brass step guards,* grooved and about 2 in. wide, are often used, as shown in the drawing; two of them are placed on each step, one on the nosing and one further back, with a space of 2 in.

between. The sheeting at the back is tongued-and-grooved and fitted between the rebates in the strings. The joints, which are



painted prior to being nailed in position, have a **V** worked on the under side to break the joint. Galvanised or copper nails

are used in fixing the sheeting to the treads. The sheeting is not carried down to the deck, but is stopped at the bottom tread, to allow any water on the deck to pass freely under the ladder.

The *steel handrail* is 3 ft. 6 in. high around the opening, and 2 ft. 9 in. high on the stair. The stair handrail is bolted to the ladder sides, and the rail around the opening is fixed to the cover board by a triangular cast-steel flange screwed to same.

Fig. 451 shows an elevation looking forward, and Fig. 450 shows a sectional elevation on *AA*. The plan, Fig. 452, is a full plan of the opening, excepting one corner, which is cut away to show the shoe at the foot of the ladder.

Section *BB*, Fig. 454, shows the housing and rabbeting of the ladder side to receive the treads and sheeting.

In *setting out*, the ladder sides should be fastened temporarily together and the lines marked with the bevel, and squared over to ensure both sides being exactly alike.

The ladder should be bevelled to allow the treads to follow the camber of the deck.

Board of Trade Regulations.—The BOARD OF TRADE issue regulations relating to Emigrant ships, and the following are a few selected because of their special bearing on the construction of stairs, and apply to *stairways* or *ladders* leading to a *weather deck :*

Separate stairways or ladders are to be provided for each *passenger compartment*, and in no case may the only means of access to a compartment consist of openings through a watertight bulkhead, unless these openings are trunked *watertight* to the same height as the bulkhead.

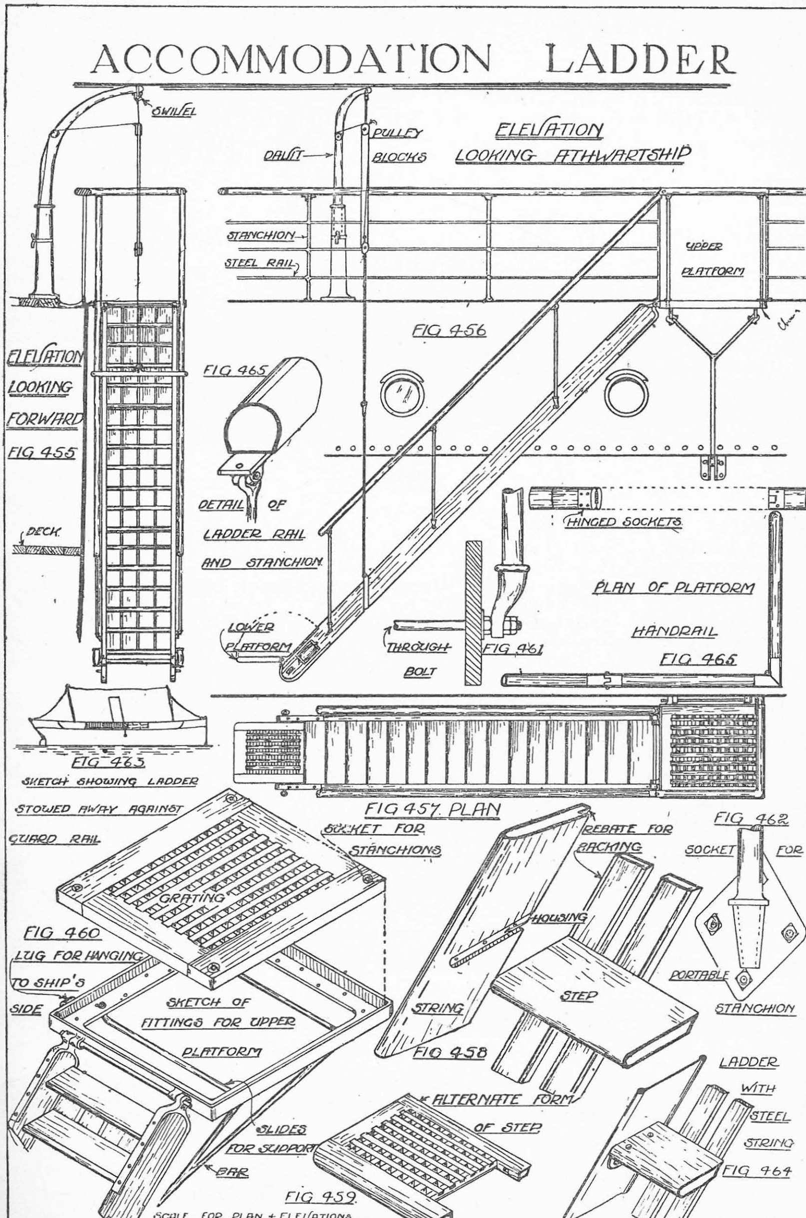
When a compartment provides accommodation for a *large number* of passengers, the stairways should be distributed in such a manner as to prevent *congestion* at any part of the compartment.

The aggregate *width* of the stairways or ladders from each compartment is not to be less than *2 in. for every five adults* accommodated in the compartment or compartments from which the stairways lead. In the case, however, of stairways which give access to the weather deck for the passengers berthed in three or more compartments, one above the other, the stairways leading from the uppermost compartment to the weather deck are to have an aggregate width of 2 in. for every five adults in the two compartments which accommodate the largest numbers, plus 1 in. for every five adults in the remaining compartment or compartments.

For example, if 300 passengers are berthed in a compartment on the lowest passenger deck, 200 passengers in the compartment immediately above it, and 100 in the compartment above that again, and if the whole 600 passengers require to use the same stairways, the aggregate width of the stairways leading from the uppermost compartment to the weather deck is to be

$$\frac{2}{5}\left(300+200\right)+\left(\frac{1}{5}\times 100\right)=220 \text{ in.}$$

No ladder or stairway is to be less than *30 in.* in width. No stairway is to be more than *50 in.* in width unless fitted with an *intermediate rail* or rails ; such rails are not to be less than 30 in. or more than 50 in. apart. The width of all ladders and stairways should be measured on the tread,


ACCOMMODATION LADDER
SWIVEL
DAVIT
PULLEY BLOCKS
ELEVATION LOOKING ATHWARTSHIP
STANCHION
STEEL RAIL
UPPER PLATFORM
FIG 456
ELEVATION LOOKING FORWARD FIG 455
FIG 465
DETAIL OF LADDER RAIL AND STANCHION
DECK
HINGED SOCKETS
PLAN OF PLATFORM HANDRAIL FIG 465
LOWER PLATFORM
THROUGH BOLT
FIG 461
FIG 463
SKETCH SHOWING LADDER STOWED AWAY AGAINST GUARD RAIL
FIG 457 PLAN
SOCKET FOR STANCHIONS
REBATE FOR RACKING
FIG 462
SOCKET FOR PORTABLE STANCHION
GRATING
FIG 460
LUG FOR HANGING TO SHIP'S SIDE
HOUSING
SKETCH OF FITTINGS FOR UPPER PLATFORM
STRING
STEP
FIG 458
SLIDES FOR SUPPORT BAR
ALTERNATE FORM OF STEP
LADDER WITH STEEL STRING
FIG 464
FIG 459
SCALE FOR PLAN + ELEVATIONS.
0 1 2 3 4 5 6 7

or step, and within the sides, unless the handrails encroach on the tread or step, in which case the distance between the rails is to be taken as the width.

There should be at least *six clear feet space in a vertical direction* above each stair.

Ladders should as far as possible be *pitched fore and aft*, and should not be too steep, the angle from the vertical being as near 37° as the arrangements of the ship will admit. All ladders intended for the accommodation of women are to be lined on the back.

The reader wishing to further his knowledge of these regulations should obtain the Board's circular, "Instructions relating to Emigrant Ships."

Accommodation Ladder.—These ladders are suspended over the side of the ship for the purpose of taking passengers or pilots aboard when the vessel is at sea. They are usually on the starboard side and facing the after end, but large ships often carry a ladder on the port side as well. If the ladders require to be very long, they are made in *two flights*, and a centre platform is interposed between the upper and lower flights.

In designing accommodation ladders, the varying heights of passenger deck above the *water-line* must be taken into account: for example, when the ship is under weigh, with full load, there may be several feet of difference in this height than when working to light load. Also, the type of boat or tender from which the passengers embark should be taken into account in deciding the length of ladder. In any case, it should be long enough to reach the *water-line when the ship is under its lightest load.*

Different forms of *extending ladders* with adjustable steps are manufactured to meet the varying heights and angles to which the ladder may be working. In the case of the fixed step, however, which is similar to the one here illustrated, the ladder is arranged to work at an angle of 45°. It is desirable that the step should be as nearly horizontal as possible, otherwise the ladder is dangerous to use.

Construction of Ladder: The ladder is made up of *strings*, 9 in. by 2 in., with treads 8 in. by 1½ in. housed into the strings and nailed. The nails, which are galvanised, are punched below the surface and the holes made good with a dowel. A *wood back*, made of pieces 6 in. by ¾ in., is nailed to the splayed edges of the treads. This backing is left open (about 1 in. between each piece) to allow the water to escape. *Through bolts* are inserted at intervals, to prevent the ladder sides coming apart. These details will be clear on examination of Figs. 456 to 458.

The *steelwork*, which is galvanised, forms an important part of the ladder. The string is hooped at the bottom, and a strap hinge is fixed at the upper end; a bar with *cotter pin* passes through the hinge and hangs the ladder to the upper platform.

The lower platform is also hinged with large strap hinges to fold over.

The *steps* are often solid, but in some cases are framed, as shown in Fig. 459. The centre part is filled in with *grating*, which is not nearly so slippery as the solid step.

Buffer rollers revolving in a small iron frame are bolted to the lower end of the strings to reduce the friction in case the ladder works against a small boat; and, in some cases, a long fender of elm, bolted to the side of the ladder and extended several feet into the water, is fitted to prevent a small boat from coming in contact with the side of the ship. *Eye bolts* are also attached to the lower end of the string for the purpose of temporarily lashing a small boat.

The upper platform is framed together and fitted with grating; see Fig. 460. A heavy casting receives the wood framing, the latter being fixed by screws from underneath. The method of holding the platform in a horizontal position is by means of a Y-*shaped steel strut*, or "collapsible crutch" as it is sometimes called. The forked end of the strut slides on steel bars bolted to the cast-iron platform. The strut will fold into a vertical position along with the platform when not in use. The platform casting has two pairs of lugs, one pair to hang the platform to the ship's side, and one pair on to which the ladder is hung.

There are various methods of supporting the handrail, some of which fold up with the ladder, while others are arranged with *portable stanchions* to lift out, so that they can be stowed away. In the particular case dealt with, the stanchions around the platform fit tightly into sockets, and a chain and pin underneath prevent them from being lifted out. They can be lifted out and folded up against the handrail when not in use. The *sloping* handrail rests on stanchions, which can revolve to suit the angle of the ladder; also, by means of these stanchions, the handrail can fold down against the ladder side, when not in use. Fig. 461 shows the stanchion *socket* on the end of a through bolt. The upper end of the handrail is attached to the platform handrail by a brass hinged joint, and a portable pin, which hangs on a chain ready for use; see Fig. 465. Instead of a handrail, a rope often has to serve the same purpose, in which case stanchions with square tapered sockets are used; see Fig. 462.

When not in use, the ladder is stowed against the guard rail or bulwark, as shown in Fig. 463. *Pulley blocks* and *davit* are used for suspending the ladder over the ship's side; see Figs. 455 and 456.

Steel strings are coming more into use. **I**-section bulb is used, to which lugs are bolted to receive the ends of the treads, as shown in Fig. 464.

Pilot ladders are made up of treads with holes bored in them through which a rope passes, and knots on the rope support the treads. It is tied to the guard rail and suspended down the ship's side. Teak or pitchpine is used for these ladders.

STAIRS

Straight Stairs are often seen in large passenger vessels and, as far as construction is concerned, are the simplest and most easily understood. Therefore, before going to more difficult examples, the craftsman would do well to master the principles underlying the construction of the straight type.

Terms.—The following are some of the terms used in stair construction, together with a brief definition of each :

A *Step* is composed of a tread and a riser.

The *Going* is the horizontal distance between the faces of two risers.

A *Riser* is the vertical distance between the upper surfaces of two treads.

A *Tread* is the horizontal part of a step.

Stringers, or *strings,* are the outer inclined pieces which support the ends of the steps.

Flyers are parallel steps, as used in straight flights.

Winders are tapered steps used in turning corners.

Commode steps are the lower steps of a stair and have curved risers.

A *Curtail step* is the bottom step and has scroll-shaped ends.

A *Bullnose step* has a straight front and rounded ends.

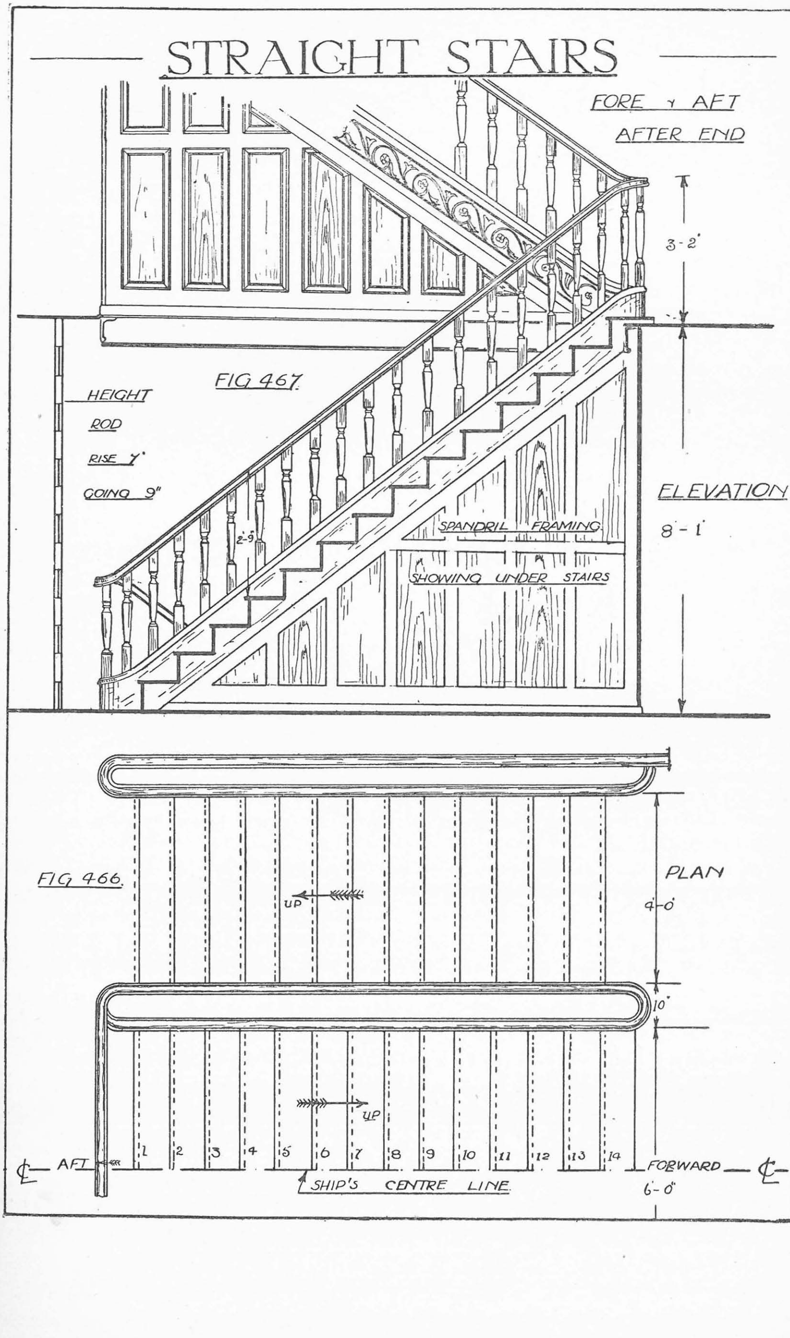
Spandril framing is the triangular-shaped framing under the stair.

A Wreath is the portion of a handrail carried around a curved and inclined part in the stair.

A *Landing* is a horizontal resting-place in the ascent of a stair, often adopted where a change of direction is necessary.

Construction of Straight Stairs : The stair shown is composed of *two flights* on the promenade deck converging into a *single flight* on the deck below. The single flight should almost have the same capacity as the two upper ones, with such reduction as is necessary for the different numbers of passengers who would be using the stair from each deck. The height from deck to deck is 8 ft. 1 in., and if we add 2 in. for cover board and subtract 1 in. due to sheer, this leaves 8 ft. 2 in. ; dividing this into *fourteen risers* we get a *rise* of 7 in. per tread. The *going* has been taken at 9 in.

The plan, Fig. 466, shows the *general arrangement* of the stairs. The single flight has a width of 6 ft., and in the double flight


STRAIGHT STAIRS
FORE & AFT
AFTER END
3 - 2"
FIG 467
HEIGHT
ROD
RISE 7"
GOING 9"
2-9
ELEVATION
8 - 1"
SPANDRIL FRAMING
SHOWING UNDER STAIRS
FIG 466.
UP
PLAN
4-0"
10"
UP
1
2
3
4
5
6
7
8
9
10
11
12
13
14
AFT
FORWARD
SHIP'S CENTRE LINE.
6-0"

each stair has a width of 4 ft., taken to the inside of the strings. The dotted lines show the face of the risers, and the step number 14 is the cover board on the deck. The handrail is also shown in plan, and at the top is fixed to a bulkhead. It will be noticed that the stairs are on the fore-and-aft centre line and, being symmetrical, only half of the plan is shown.

The sectional elevation, Fig. 467, is taken on the ship's centre line, and the treads and risers are shown clearly by thick section lines. The string is 11 in. by 2 in., and the upper edge is fitted with a *capping*. The top of the handrail is 2 ft. 9 in. above the nosing, and the balusters are spaced 4 in. apart. They are mortised to the capping, and bevelled and screwed to the handrail. The stringers are often carved, or built up, to form ornamental designs, and a simple case of *incised carving* is adopted in the one shown.

The space under the stairs is utilised as a store and is fitted with shelves: it is enclosed by framing, known as *spandril framing*. Further details of stair construction are given in Figs. 470 to 490.

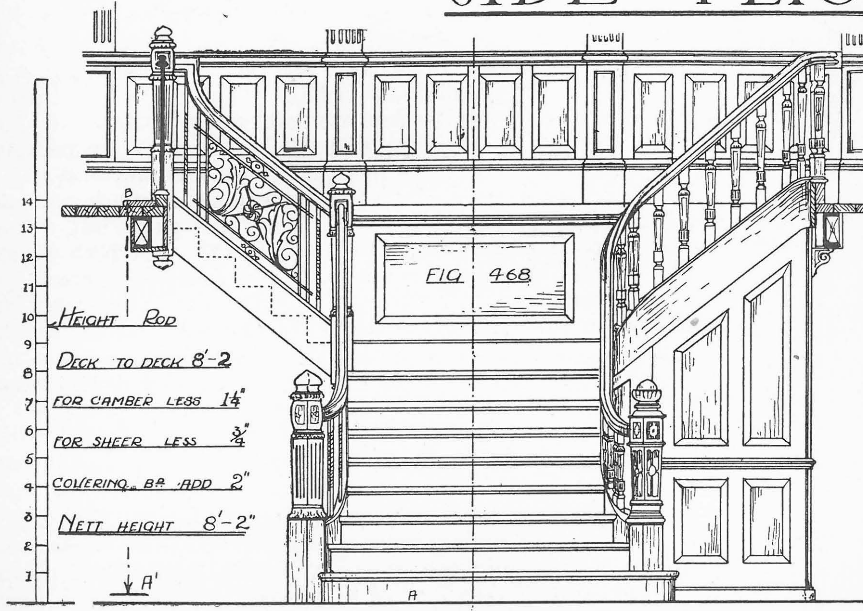
Side-flight Stairs.—This type of stair is frequently met with in passenger liners. It has many good points to recommend its adoption, amongst which are: it occupies a comparatively small amount of deck space; it is an "easy" stair on account of it having a centre landing, which is usually arranged a little above the centre of the height; it can be made as simple or ornate as the circumstances require; it has an elegant appearance.

The two *side flights* are arranged to be as convenient for passengers as possible, as will be seen from the plan, Fig. 471. These flights collect the passengers from the port and starboard alleyways, and the centre flight leads down to the dining saloon on the deck below. It often happens that the arrangement of the alleyways and public rooms means the reversing of this order, when the two side flights would be placed at the bottom.

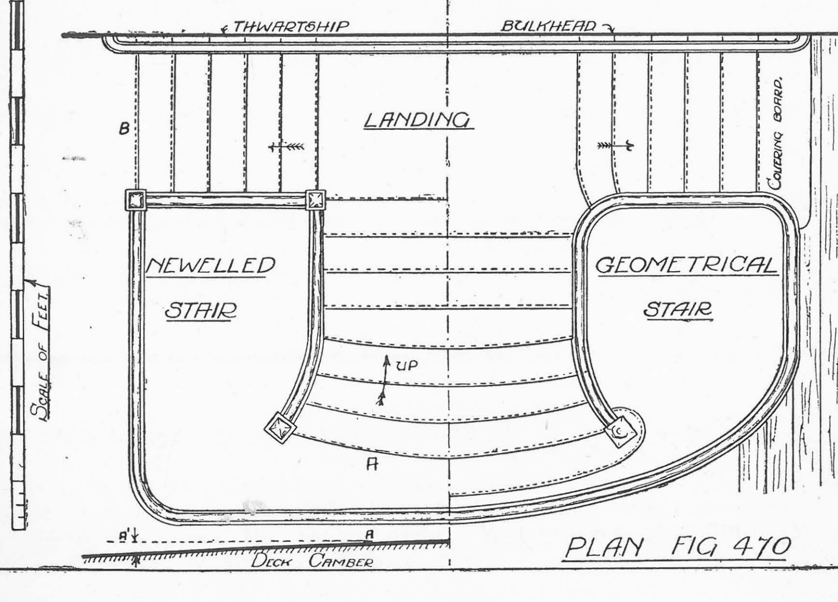
On account of the importance of saving space aboard ships, stairs generally are very steep, that is, compared with stairs seen in buildings ashore. A 10-in. or even a 12-in. step is occasionally seen, but the general run is not more than 8 in. to 9 in. The one shown works out about $9\frac{1}{2}$ in. going and 7 in. rise, which is considered quite a comfortable slope in ships' stairs.

The opening in the deck to receive the stairs is made good by riveting in a fore-and-aft carling to receive the ends of the short deck beams. In arranging the number of deck beams to be cut, special attention must be paid to the headroom. The stair is supported on steel *carriages*, riveted to the fore-and-aft carling, and extended athwartship; while fore-and-aft carriages support the centre flight. Wood brackets are fixed to the steel carriages to support each tread; see Fig. 472.

—SIDE FLIG

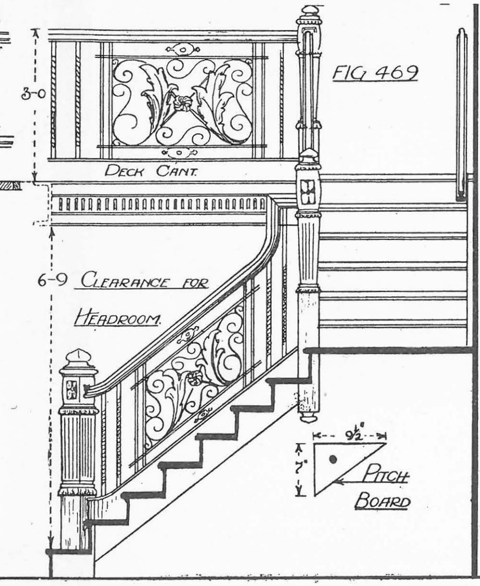


— FRONT ELEVATION —

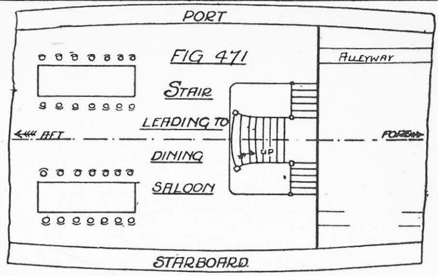


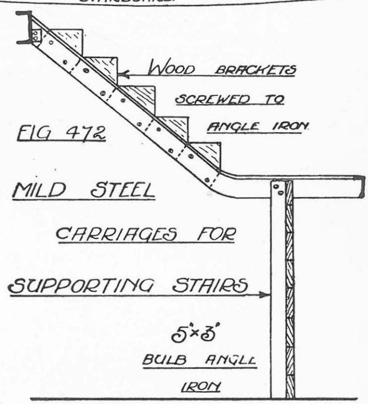
PLAN FIG 470

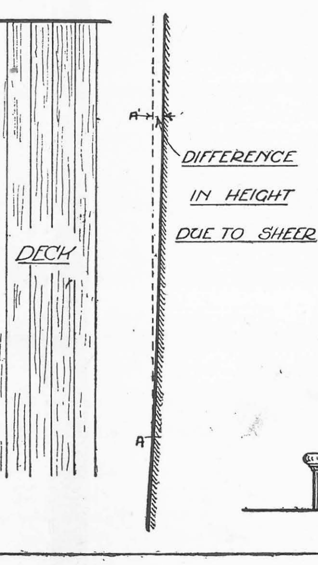
HT STAIRS

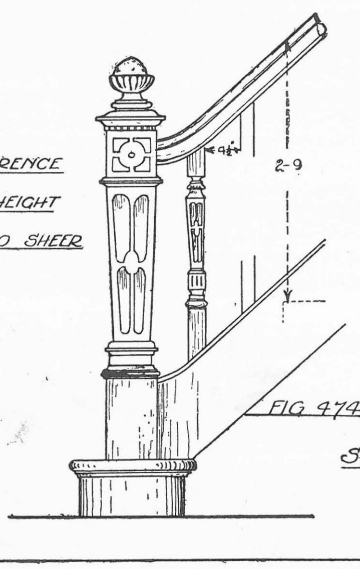


— SECTIONAL ELEVATION —

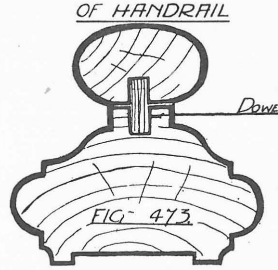






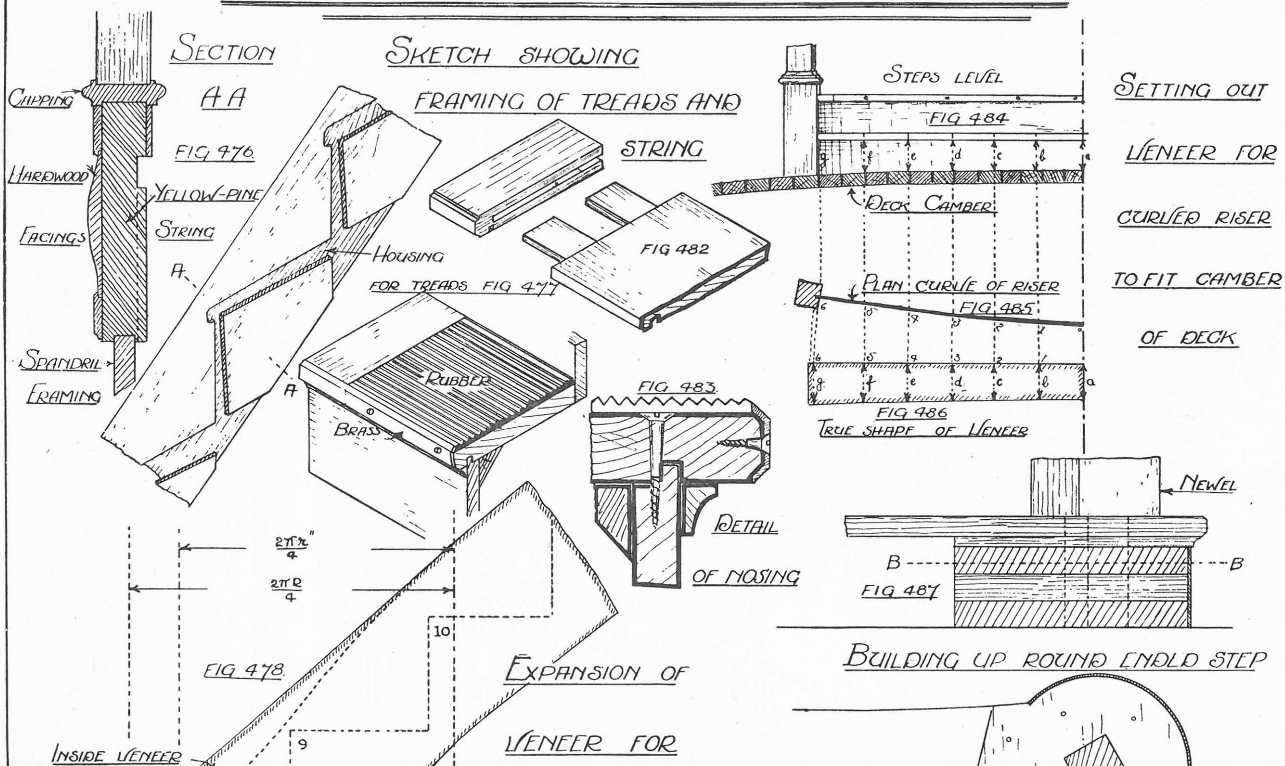


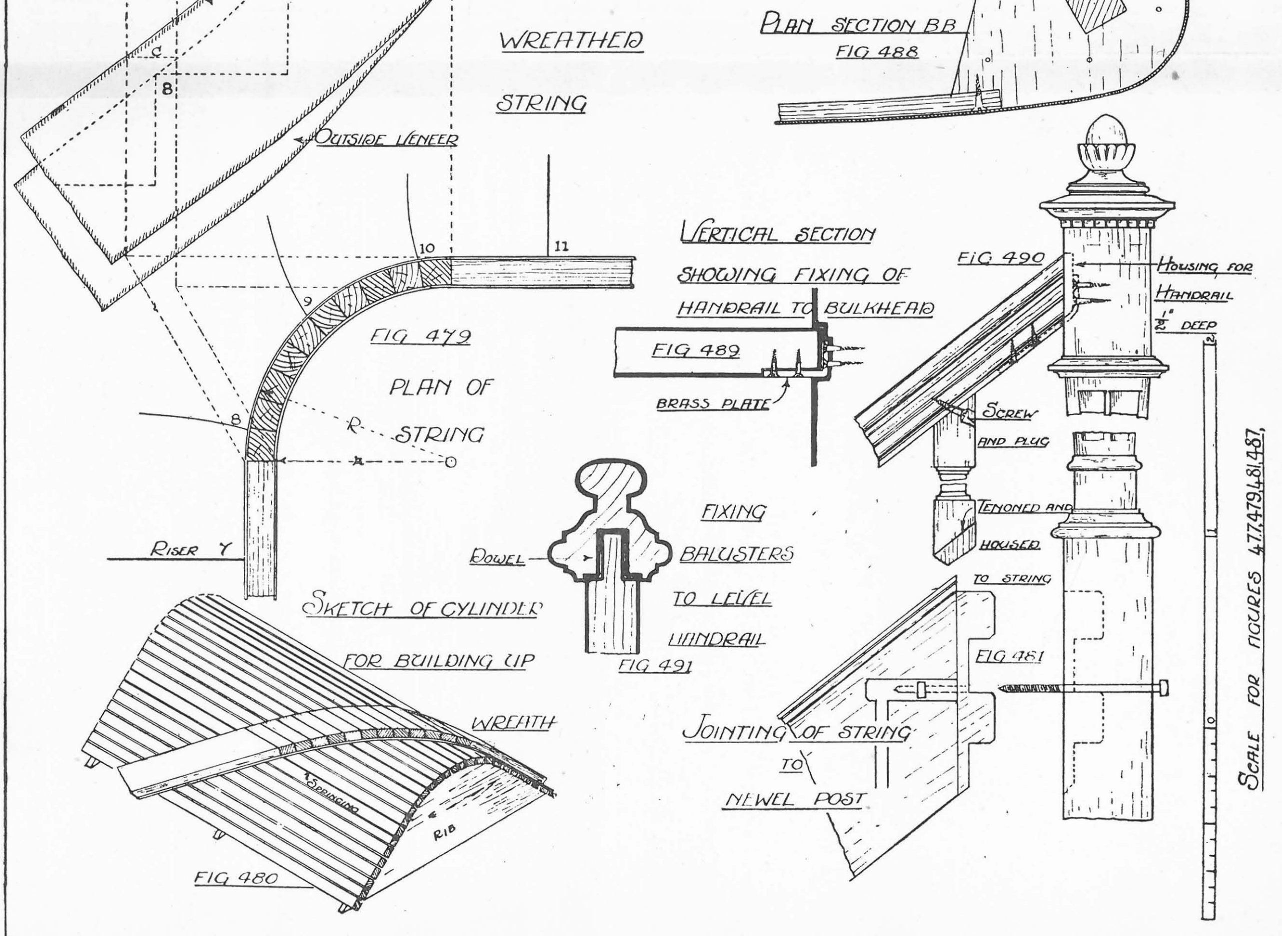
FULL SIZE SECTION OF HANDRAIL



ENLARGED SKETCH OF STAIR BOTTOM.

SHIPS STAIR DETAILS




WREATHED
STRING
Outside Veneer
8
c
10
11
9
8
R
FIG 479
PLAN OF
STRING
Riser Y
Sketch of Cylinder
for Building Up
Wreath
Springing
Rib
FIG 480
Plan Section BB
FIG 488
Vertical Section
Showing Fixing of
Handrail to Bulkhead
FIG 489
Brass Plate
Dowel
Fixing
Balusters
to Level
Handrail
FIG 491
FIG 490
Housing for
Handrail
1/2" deep
Screw
and Plug
Tenoned and
Housed
to String
FIG 481
Jointing of String
to
Newel Post
Scale for figures 477,479,481,487,
0
1
2

Setting Out: In taking the *height* of the stairs, that is, the distance from one deck to the next, allowance must be made for the *curvature* of the deck. The height is marked on a *rod*, and is taken on the walking line *A* to *B*; see Fig. 470. (The walking line is usually taken as 1 ft. 6 in. from the handrail.) If it were possible to level a line from *A* to *A′* so that *A′* would be directly underneath *B*, then the height would be *A′* to *B*, as seen in elevation, Fig. 468. Or the height can be taken by reference to the beam mould and height staff, as explained in the chapter on Geometry.

For example:

Height, deck to deck	=8 ft. 2 in.
Subtract $1\frac{1}{4}$ in. due to camber	=8 ft. $\frac{3}{4}$ in.
Subtract $\frac{3}{4}$ in. due to sheer	=8 ft.
Add 2 in. for covering board	=8 ft. 2 in.

which is the net vertical height *A* to *B*.

This height is set on the rod and divided to suit the number of risers; in this case 14 has been adopted, so that the rise equals 8 ft. 2 in., divided by 14, which equals 7 in.

The ratio of rise to going can be calculated from the formula:

$$\text{Rise} \times \text{Going} = 66 \text{ in.}$$

Taking the rise as 7 in., then going $=\frac{66}{7}=9\frac{3}{7}$ in., and $9\frac{1}{2}$ in. is adopted.

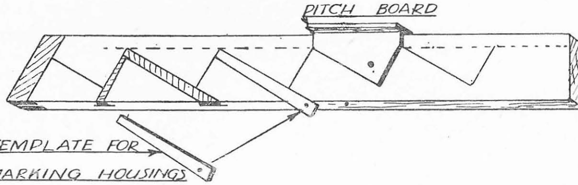
The accompanying drawings give the general arrangement of the stairs: Figs. 468 and 469 show elevations, and Fig. 470 gives the plan. The *left-hand* side of the drawing shows a newel stair, and the *right-hand* side a geometrical stair (having a continuous handrail except for a newel placed at the bottom). The bottom four steps are rounded at the front, and are termed *commode steps*. It is important to note that the steps are all *level* and do not follow the curvature of the decks.

The *balustrade* of the newel stair is made up of a handrail, capping, and ornamental ironwork; while the geometrical stair has balusters in place of the ironwork. A handrail is fixed on the thwartship bulkhead, and the ends are returned into square blocks fixed to the bulkhead.

Ship's Stair Details.—In setting out the strings to receive the ends of the treads and risers, a *pitch board* is required. The pitch board is made by setting out the going and rise at right angles to each other, and joining up the points to form a triangle. A sketch of a pitch board, and its application to the setting out of a string, is shown in Fig. 475. The strings are usually made of yellow pine faced with hardwood veneers. Yellow pine has

the advantage of being much lighter than solid hardwood, and lends itself to any form of decoration by veneers or moulded facings. A section of a string is shown in Fig. 476.

FIG 475 MARKING OUT STRING



Wreathed String: The wreathed parts of the string are sometimes built up out of three or four solid sections, but are more often *staved;* an example of this is seen in the quarter turn of the geometrical stair shown in Fig. 470. Fig. 478 gives the expansion, or development, of the veneers, one for the inside, or step side, of the string, and one for the outside. The *plan length* of the veneers is developed in elevation; this length can either be stepped off from the plan, Fig. 479, or calculated. To obtain the shape of the veneers: set out the position of the risers and treads on the development, and draw in the veneer with a suitable curve, keeping the proper distance from the nosings to the upper edge of the string. It will be noticed that the outside veneer has to rise to the same height in a shorter length; and in the drawing a horizontal dotted line marked

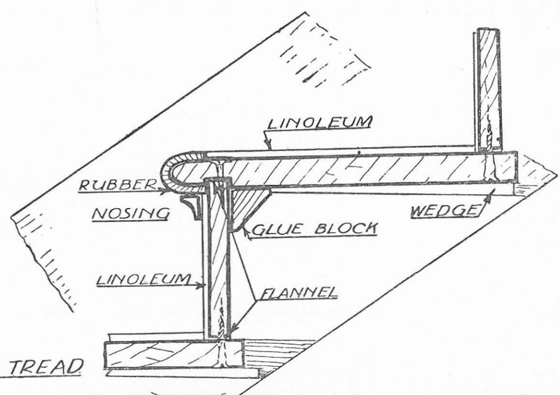


FIG 492 SECTION THROUGH RISER AND TREAD

C transfers the height from the springing of the outer curve to the springing on the inner curve, and a suitable outline of veneer is drawn in.

Fig. 480 shows the method of building up the veneer by laying it over a cylinder prepared to the proper radius, and gluing the staves on to the veneer. The staves are bevelled to radiate to a common centre.

The strings are housed to receive the ends of the steps, and are then jointed to the newel posts; tenon joints are used, as shown in Fig. 481, and, where possible, a bolt is inserted as shown. The tenons are also pinned from the inside.

Fixing Treads and Risers: The steps (that is, the treads and risers) are next prepared. There are various methods of finishing the treads. Figs. 477 and 483 show one method: the tread is covered with rubber to within a few inches of the end, the treads being clamped at the ends to form a stop for the rubber. A brass plate is also screwed on the nosing of the tread. The joint between the riser and tread is formed by a tongue and groove, and should be glue-blocked underneath and screwed.

Fig. 492 shows another method: the whole of the tread is covered with thick linoleum, and a rubber nosing is fixed to the edge of the tread. The joint between tread and riser is covered with flannel, to prevent squeaking, and is screwed and glue-blocked.

The *curved risers* at the bottom of the stair are built up in sections and veneered. The shape of the veneer suitable for the bottom step is fully set out in Figs. 484 to 486. The plan curve, Fig. 485, is stepped off on a straight line *1-6*, Fig. 468, representing the upper edge of riser. The corresponding heights at these points are transferred from the elevation, and set down as *a*, *b*, *c*, etc., at right angles to the line *1-6*. A fair curve drawn through these points delineates the shape of the veneer to fit the camber of the deck. Any slight deviation from this shape due to sheer (which is almost negligible) is made up for in a small allowance left for *scribing* to the deck.

Figs. 487 to 488 show the building up of a round-ended step. Three thicknesses of yellow pine are glued and screwed together, cut out to the shape, and afterwards mortised to receive the newel post. The scotia for same is worked on a solid piece, and fixed to the block. The round end is veneered.

Large stairs, especially where several flights are of the same design, are built in the shop on *temporary wood carriages* fixed up for the purpose; by this means, each part can be carefully fitted, and as much of the work temporarily fixed as possible.

Fixing Handrails and Balusters: The *handrails* are fitted in the ship, after the stairs are erected. The section of handrail shown in Fig. 473 is a common one, though many shapes are met with. It is made in two parts, which are prepared separately and then fixed together by dowelling. Fig. 489 shows a method of fixing the handrail to a bulkhead, and Fig. 490 shows the fixing to a newel post. In the latter case, a

brass *knee-plate* is bent, and fixed, first to the newel, and then to the handrail, the latter being housed into the newel.

The upper edge of the string is finished with a *capping,* which is wreathed at the different turns and carried around the well.

The *balusters* are housed and tenoned to the cappings, and are cut to the slope of the handrail, being fixed to the latter by a screw, as shown in Fig. 490. The balusters round the landings are fixed by a *dowel,* which is turned on the solid baluster (see section, Fig. 491), and the bottom is housed and dowelled to the capping. In fixing ironwork in the balustrade, an *iron core* is usually riveted to the ironwork on which the handrail rests, the handrail being fixed to the iron core by means of wood screws.

Stairs of the *open string* type do not lend themselves to the steep pitch of ships' stairs, as it interferes with a good spacing of the balusters; hence the close string type is more in evidence.

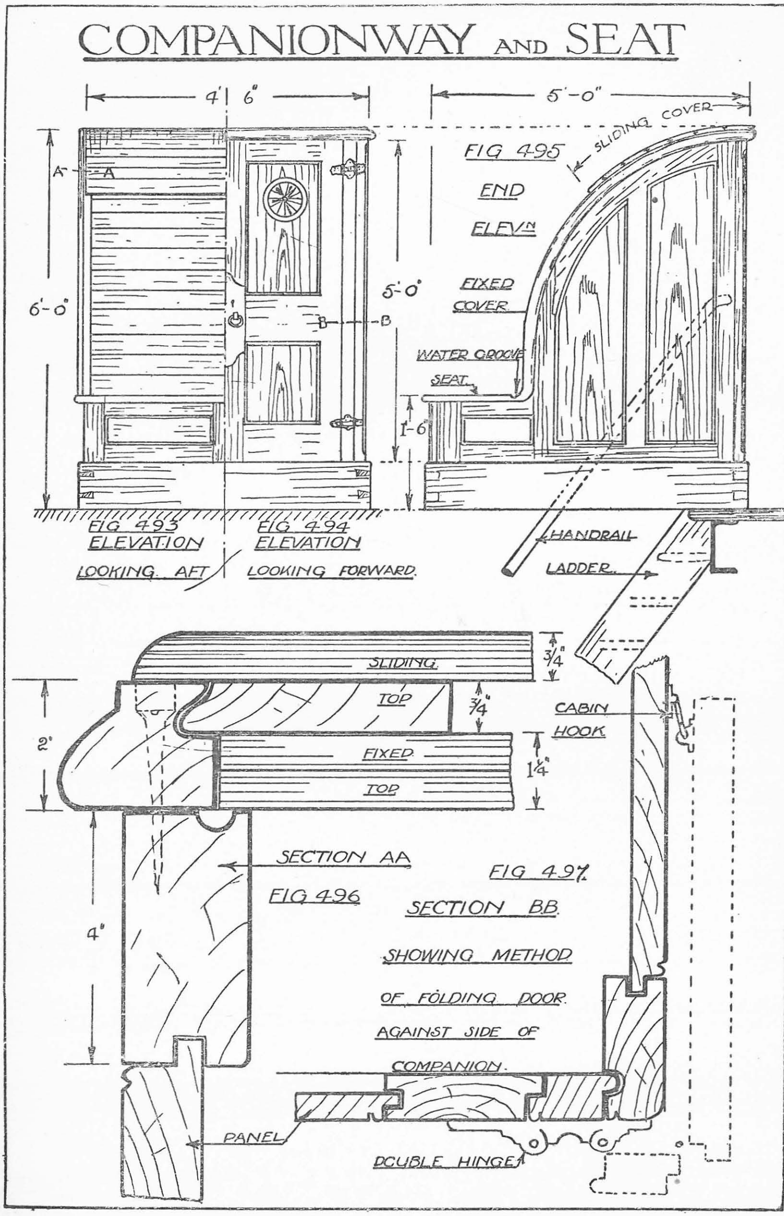
COMPANIONWAY AND SEAT

Companionways are for covering in and making watertight a stairway which has an exit on to a weather deck. They provide shelter against rain, and enclose the stair well, so that the bottom of the stair may lead directly into a public room. They are, however, almost obsolete, being rapidly replaced by the deck-house as a permanent structure on the upper decks. They are at present used chiefly in small boats; or, in some cases, they are seen in the *bow* or *poop,* where they are used as a means of communication to the seamen's quarters. The stairway, which is usually a straight flight from one deck to the other, is similar to the one described previously.

The **hood,** or **cover,** is sometimes sloped like an ordinary lean-to roof, but in most cases it is circular, as shown, and forms a quarter-circle. The hood, of course, must be of some shape to throw off the water, and should be of such a height as to give the necessary headroom underneath. The headroom practically governs the shape of the hood, which is kept as small as possible so as to offer the least resistance to wind. The size of the two doors should be the same as the width of the stair. The lower part of the companionway is formed into a *deck seat,* as seen in end elevation, Fig. 495; in some cases, the sides of the seat are fitted with sashes to give light to the stairway.

The hood is built up similarly to a barrel with laggings, and to give extra headroom the upper portion of the hood is made to slide down over the lower part. Section *AA*, Fig. 496, shows the sliding arrangement.

The *sliding cover* is made up of two curved bars, to which the tongued-and-grooved laggings are screwed, and the cover slides


COMPANIONWAY AND SEAT
4' 6"
5'-0"
SLIDING COVER
FIG 495
END
ELEVN
FIXED
COVER
WATER GROOVE
SEAT
6'-0"
5'-0"
1'-6"
A
A
B
B
FIG 493
ELEVATION
LOOKING AFT
FIG 494
ELEVATION
LOOKING FORWARD.
HANDRAIL
LADDER
SLIDING
TOP
FIXED
TOP
3/4"
3/4"
1¼"
2"
4"
CABIN
HOOK
SECTION AA
FIG 496
FIG 497
SECTION BB
SHOWING METHOD
OF FOLDING DOOR
AGAINST SIDE OF
COMPANION.
PANEL
DOUBLE HINGE

in a curved *race* fixed to the ends of the companionway. The lower part is made up of a double thickness of sheeting, nailed to the framing, and laid *horizontally* with lap joints, as shown in elevation, looking aft, Fig. 493.

The ends are panelled, and framed up, as shown in end elevation. The seat is solid and fixed down to the framings by screwing and dowelling. A *water groove* to carry the water from the hood is run across the back of the seat. The whole framing is carried on stout coamings.

A special feature of this companionway is its **doors**, which are made to fold back and round the ends, so as to be quite out of the way when open; in this position they are kept secure by a *cabin hook*. In order to achieve this object, a double stile and a special companionway hinge are used. This arrangement will be seen in elevation looking forward, Fig. 494, and in section *BB*, Fig. 497. The hinge has *two centres*, one for each joint, in the double stile, which takes up the position as shown dotted when folded back.

The stairway is *fixed* to the deck beam by lugs and bolts, and a handrail is carried up and fixed to the inside of the companionway.

Teak or pitchpine are the woods generally used.

Booby hatches serve the same purpose as the companionway, but they are portable, being used over a temporary stairway. The whole framework is adjustable and is lashed to the deck when in use.

CHAPTER XI

DINING SALOON AND FITMENTS

PLAN of Dining Saloon, etc.—The saloon used by passengers for dining is usually situated in the hull of the vessel, and has therefore to be lighted by circular side-lights. In large liners a saloon is provided for each separate class of passengers, in addition to separate dining accommodation for the crew and officers. The usual arrangement of tables is that adopted in a modern restaurant; that is, small tables to accommodate from two to ten, with often a large table down the middle of the saloon. A plan of a small dining saloon to seat 42 persons is shown in Fig. 498. Eight small square *tables* and one long table with circular ends are fitted; also two *sideboards* and *writing table.* All the *seats* are of the revolving type, and are described later.

Part accommodation and the arrangement of stairs, swing doors, etc., are shown in the same plan.

Saloon Framing.—The public rooms aboard some of our large passenger liners are fine examples of woodwork and decoration. Many are carried out on strictly *period* lines, with elaborate ornamental details. In connection with saloon framing generally there are three forms of construction:

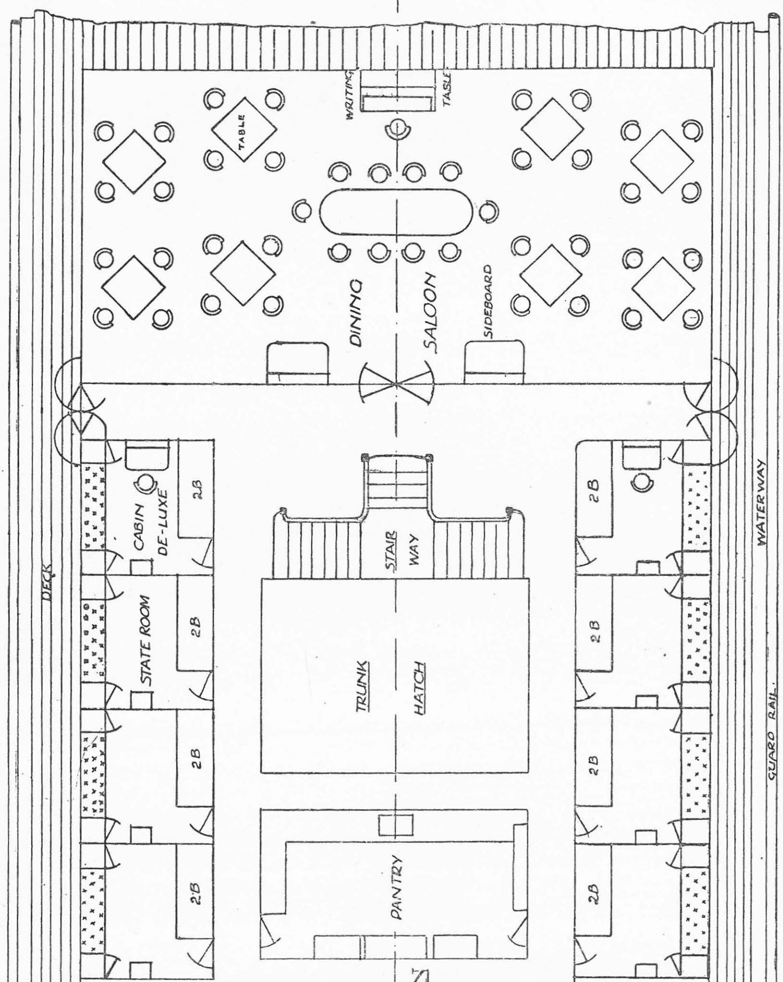
(*a*) Where the surface of the framing is simply varied by the shape of the panels and mouldings;

(*b*) Where some portion of the framing is raised over the rest—an example of this is shown in Fig. 499, the framing around the windows being placed in front of the rest, thus relieving the flat surface of its monotony;

(*c*) Where pilasters (sunk or raised) are used, to cover the joints of the frame sections, and to give relief to the surface.

The width of "repeat" in a panel or design is usually related to the spacing of the ship's frames and deck beams, especially where the latter project into the room. In the given example, the *full spacing* of steel frames has been taken as the repeat for panels.

The particular piece of framing chosen is not on any strictly period lines, but shows the modern tendency to utilise *plaster enrichments* on the wood framing. Plaster and composition work is being used largely for ceilings and ornamental features, on account of its lightness and the speed and economy attained in its erection.



PLAN OF DINING SALOON AND ACCOMMODATION

FIG 498.

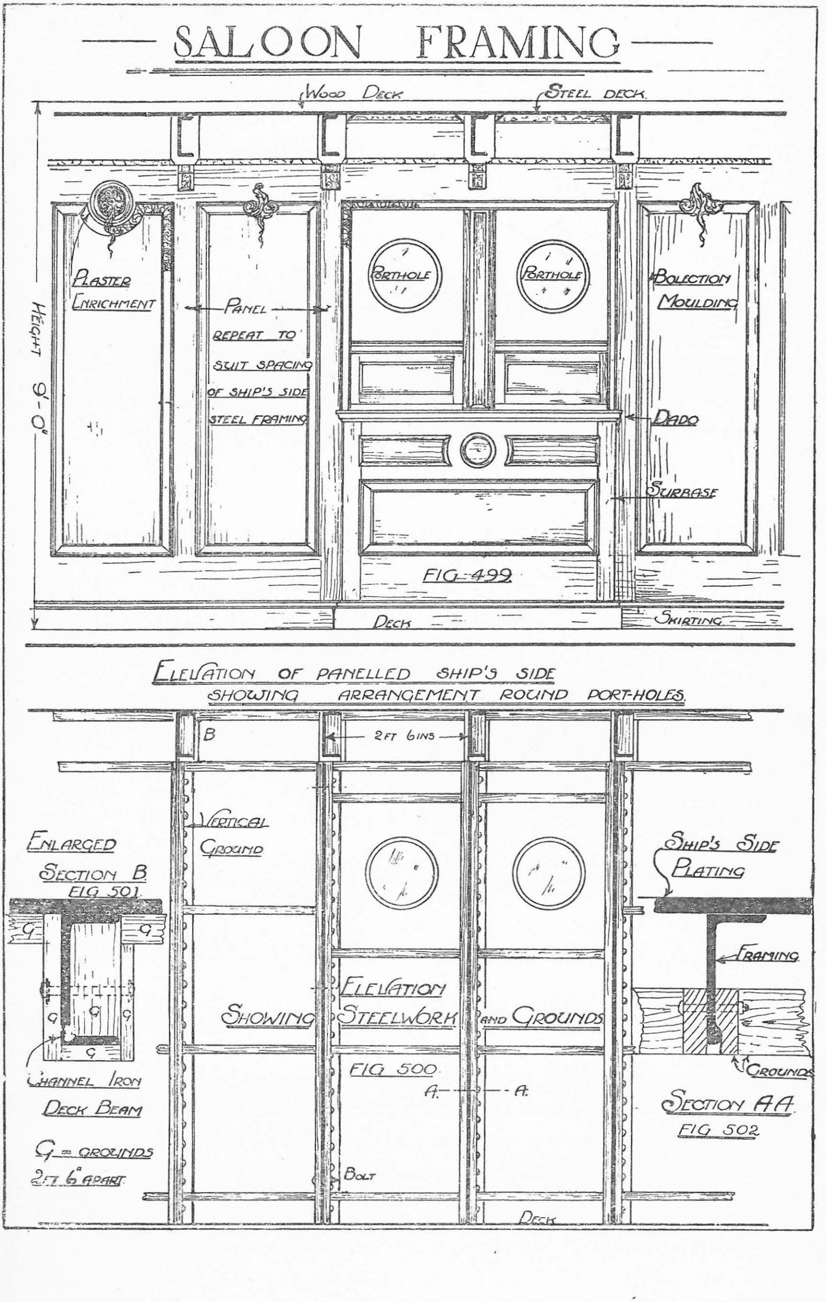


FIG 499

ELEVATION OF PANELLED SHIP'S SIDE SHOWING ARRANGEMENT ROUND PORT-HOLES.

ELEVATION

FIG 500

Figs. 500 and 502 show the ship's side framing fitted with *grounds* to receive the wood framing. The vertical grounds are $4\frac{1}{2}$ in. by $1\frac{1}{2}$ in. rough red deal bolted to the steelwork. The edge next the framing should be quite straight and plumb. It will be noticed from Fig. 503 that the grounds do not follow the moulded or rounded ship's side in a vertical direction. The horizontal grounds, or "toms" as they are sometimes called, are driven in tightly between the vertical ones and nailed in position. Fig. 501 shows the grounds fitted to a deck beam, to receive the beam facings.

The elevation, Fig. 499, shows the treatment of the framing round the two side-lights. The side-lights are arranged in pairs, between adjoining frame spacings, and open for ventilation. The framing below these side-lights is fixed after the intermediate framing is in position, and the upper panels are planted on the face of the frame. A *dado,* or *sill moulding,* is planted on the upper edge of the framing, and a skirting is fixed round the base, as shown in elevation, Fig. 499, and section, Fig. 503.

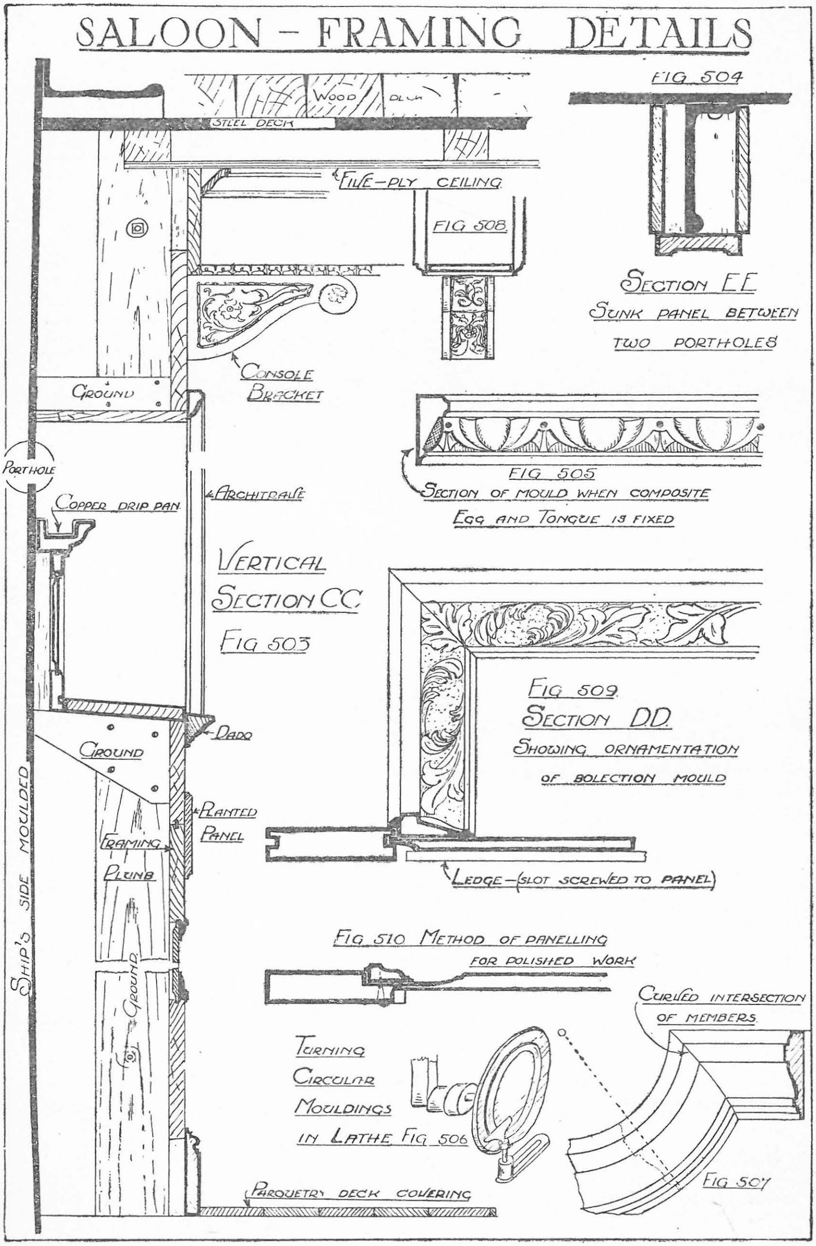
Directly under the side-lights the steel plating is covered with two small frames, and a *drip pan* is fitted into a *capping* fixed to the frames ; see section, Fig. 503.

The opening is finished with an architrave and linings, and the centre steel frame is faced in, as shown in section, Fig. 504, with sunk panel on the front. The architrave is moulded, and the large round member is ornamented by an *egg-and-tongue* enrichment, which is of plaster composition, nailed into a recess in the wood mould; see section, Fig. 505. No attempt is made to mitre the "repeats" at the angles, but a *leaf* or other form is planted over the mitre.

The ordinary framing has panels the full length, and on account of their large size should be strengthened by slot screwing *ledges* on the back. Special features in connection with this framing are the enrichments at the top of the panels. Alternate *scrolls* and *medallions* are fixed over the centre of the bolection mould, the latter being carried around the medallions, as shown in elevation, Fig. 499. The curved piece of mould is turned in the lathe, as shown in Fig. 506. Fig. 507 shows the curved intersection of the members between the straight and the circular parts of the moulding ; if many repeats of this mitre were required, a template would be cut to the required shape. A straight mitre could be arranged by slightly altering the section of the circular part.

An appearance of strength is given to the beams by fixing a bracket to each beam at its intersection with the framing. These brackets are of fibrous plaster and usually highly ornamented ; see Figs. 503 and 508.

Fixing : Painted framing can usually all be fixed by nailing


SALOON - FRAMING DETAILS
WOOD DECK
STEEL DECK
FIVE-PLY CEILING
FIG 508
FIG 504
SECTION EE
SUNK PANEL BETWEEN
TWO PORTHOLES
CONSOLE
BRACKET
GROUND
FIG 505
SECTION OF MOULD WHEN COMPOSITE
EGG AND TONGUE IS FIXED
PORTHOLE
COPPER DRIP PAN
ARCHITRAVE
VERTICAL
SECTION CC
FIG 503
FIG 509
SECTION DD
SHOWING ORNAMENTATION
OF BOLECTION MOULD
DADO
GROUND
PLANTED
PANEL
FRAMING
PLUNB
LEDGE-(SLOT SCREWED TO PANEL)
SHIP'S SIDE MOULDED
GROUND
FIG 510 METHOD OF PANELLING
FOR POLISHED WORK
CURVED INTERSECTION
OF MEMBERS
TURNING
CIRCULAR
MOULDINGS
IN LATHE FIG 506
FIG 507
PARQUETRY DECK COVERING

and screwing: the heads of the nails should be punched below the surface, and the hole made good with putty. But in *polished* work nails are sparingly used, nearly all the work being fixed by screwing. Slot-screwing is sometimes adopted for fixing pilasters, architraves, etc., and screw heads can often be hidden under cornices, dadoes, and skirtings. Where the screw heads are visible, brass screws and countersunk washers should be used.

The method of obtaining the sizes of framing is described in the chapter on Geometry.

Small Dining Saloon and Framing.—Fig. 511 shows the plan of a very small dining saloon, such as would be provided for officers. It is situated in a steel deck-house, and is entered along a thwartship passage. A seat is arranged across the forward end of saloon, and two lockers are fixed one at each end of the seat. The dining table is placed close against the seat, and measures 10 ft. 10½ in. by 2 ft. 4 in. The table is supported on cast-iron stands, and is fitted with table guards, that is, guards to prevent the victuals from sliding off when the ship is in a heavy sea. The opposite side of the table has five chairs fixed to the deck at 2 ft. centres. The length and size of the tables are, of course, governed by the number of seats; and in long tables of this kind, *2 ft. is usually allowed for each person*, with a little extra length at each end for trays, etc. In the opposite two corners are *sideboards* of the simplest type for silver and culinary appliances. Each of these separate furnishings will be dealt with in detail later, so that only a general description is here given.

The framing, and its design, is a pleasing feature in the finish of this saloon.

A neatly arranged detail round the windows is seen in the forward end, Fig. 512. The window is treated as a separate entity in the design, and the general framing between is made to suit. The windows are rectangular, and a *laying* panel is arranged directly below; small pilasters are carried up each side, and the cornice is finished with a heavy mould. The seat is upholstered and is supported on square-turned or *thurmed* legs.

The port-side elevation, Fig. 513, is also a pleasing feature. It is designed with wide and narrow panels, and a *glass and decanter rack* is fitted over the sideboard. The ceiling is of three-ply wood, and has a cornice running along the deck beams. The lower parts of the beams are exposed. A *dado* moulding is carried around the room, at a height of 3 ft., and the base is finished with a skirting mould.

Dining Saloon Details.—Further details of the saloon framing are shown in Figs. 514 to 518. The elevation of the after-end,

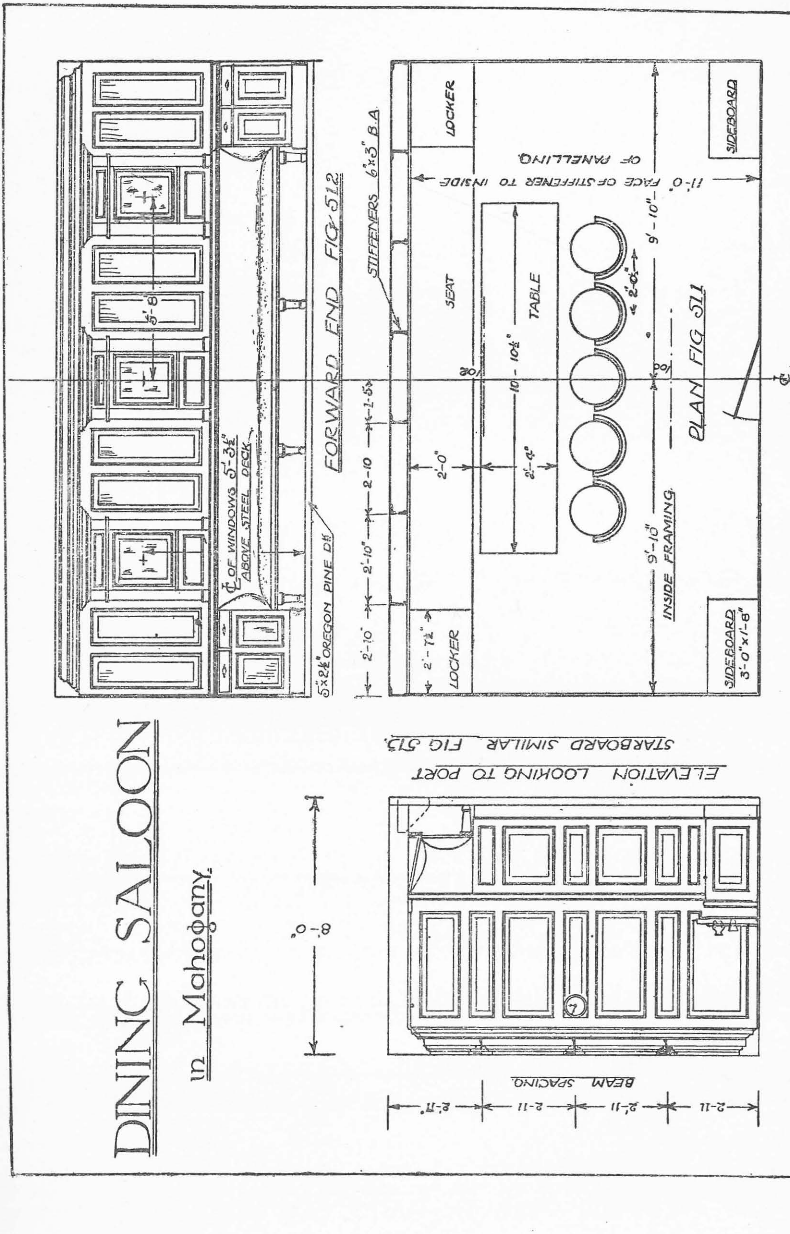

DINING SALOON
in Mahogany
FORWARD END FIG 512
PLAN FIG 511
ELEVATION LOOKING TO PORT
STARBOARD SIMILAR FIG 513.
LOCKER
SEAT
TABLE
SIDEBOARD
SIDEBOARD 3'-0" x 1'-8"
INSIDE FRAMING
STIFFENERS 6"x3" B.A.
5"x2½" OREGON PINE DK
BEAM SPACING
8'-0"

Fig. 514, shows the sideboards, with mirrors over, and the door, which opens into an alleyway. The sideboards have two cupboards below, and two drawers above. One of the cupboards is fitted with a wine cellaret, that is, a rack to hold bottles; the drawers are partitioned off, and lined with baize and made to hold cutlery. Around the top of the sideboard is a fore-edge, or sometimes a silver or brass rail; and just above is a glass and decanter rack. This rack is described in Chapter XII. Above the sideboards, mirrors are fitted over the framing. A separate frame is made for the mirrors, and a cornice is fixed across the top. The members of the moulding are returned at the ends.

The door, which is 6 ft. 6 in. by 2 ft. 6 in., is framed, and has a panel at the bottom for ventilation. The door frame is finished with architrave, plinth blocks, and cornice, as shown in elevation.

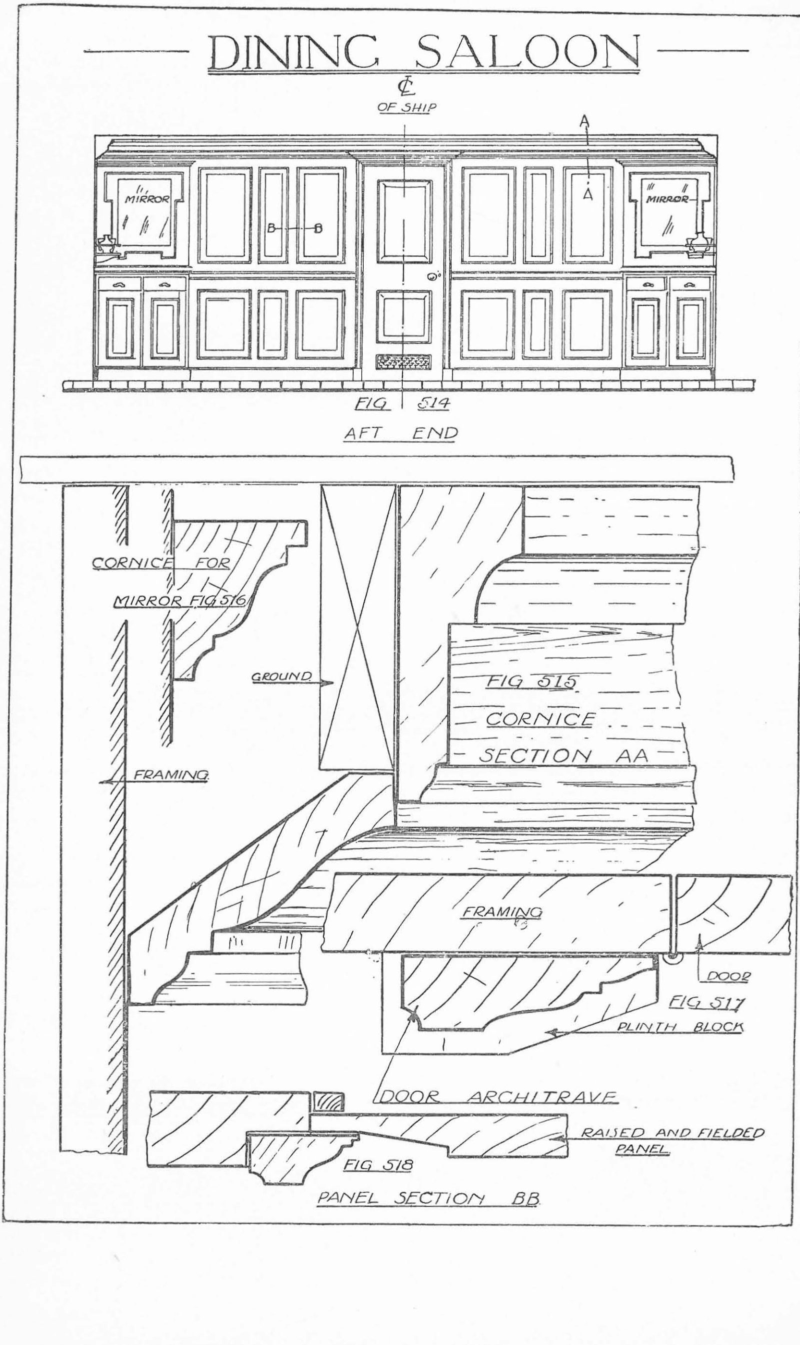
The *mouldings* form an important feature of the framing. Fig. 515 shows the cornice section at *AA*. In order to clear the steel *knee-pieces* on the deck beams, the cornice has a large projection. A vertical ground is carried across the top of the framing, being screwed to cleats which are fixed to the deck beams. To this ground the upper members of the cornice are fixed. These members are returned across the beam ends, and are carried all round the beams. The lower portion of the cornice is then fixed in position.

The *cornice* of the mirror is shown in Fig. 516; and a section for the door architrave, with plan of plinth block, is shown in Fig. 517.

The framing is rebated to receive the planting mould, as shown in panel section *BB*, Fig. 518. The panel itself is *raised* and *fielded,* and is held in by slips at the back. The mouldings are fixed by screwing from the back side, and are thus securely fixed and form one side of the groove to hold the panel. The panels are polished *before fixing* in the frame; and the grooves to receive the panels should be coated with *black-lead,* to prevent frictional noises when the ship is rolling.

Stanchion Covers.—Steel pillars, or stanchions, form an important part of the *structure* of modern steel vessels. They are arranged in rows running fore and aft, the number of rows depending upon the size of the vessel. In a saloon of large dimensions, there may be as many as 20 to 30 to be covered. These stanchions are prominent features in a public room, and offer a good field for the designer.

The **cover** illustrated has a resemblance to the classic architectural columns. Fig. 519 shows the steel stanchion fixed in position—its upper end supporting a deck beam, and its lower


DINING SALOON
℄
OF SHIP
A
A
MIRROR
MIRROR
B
B
FIG 514
AFT END
CORNICE FOR
MIRROR FIG 516
GROUND
FIG 515
CORNICE
SECTION AA
FRAMING
FRAMING
DOOR
FIG 517
PLINTH BLOCK
DOOR ARCHITRAVE
RAISED AND FIELDED
PANEL
FIG 518
PANEL SECTION BB

of shafts of similar design are required. A stout box is made with two of its sides left open. The ends of the box are bored to take the dividing heads and shaft, so as to be parallel to the spindle bench. The *dividing head*, or disc, seen in Fig. 527, is notched to suit the number of flutes required. This is fixed centrally to the shaft, and laid in the box where it can revolve. The amount of turn is regulated by a *toggle*, which is hinged, and drops into the notches in the dividing head. To determine the "stop" for the flutes, a piece of wood is screwed to the spindle bench. The side of the box, next to the spindle, is shaped parallel to the entasis of the column. By this method good results can be obtained. The stops on the reeds of course require to be finished by hand.

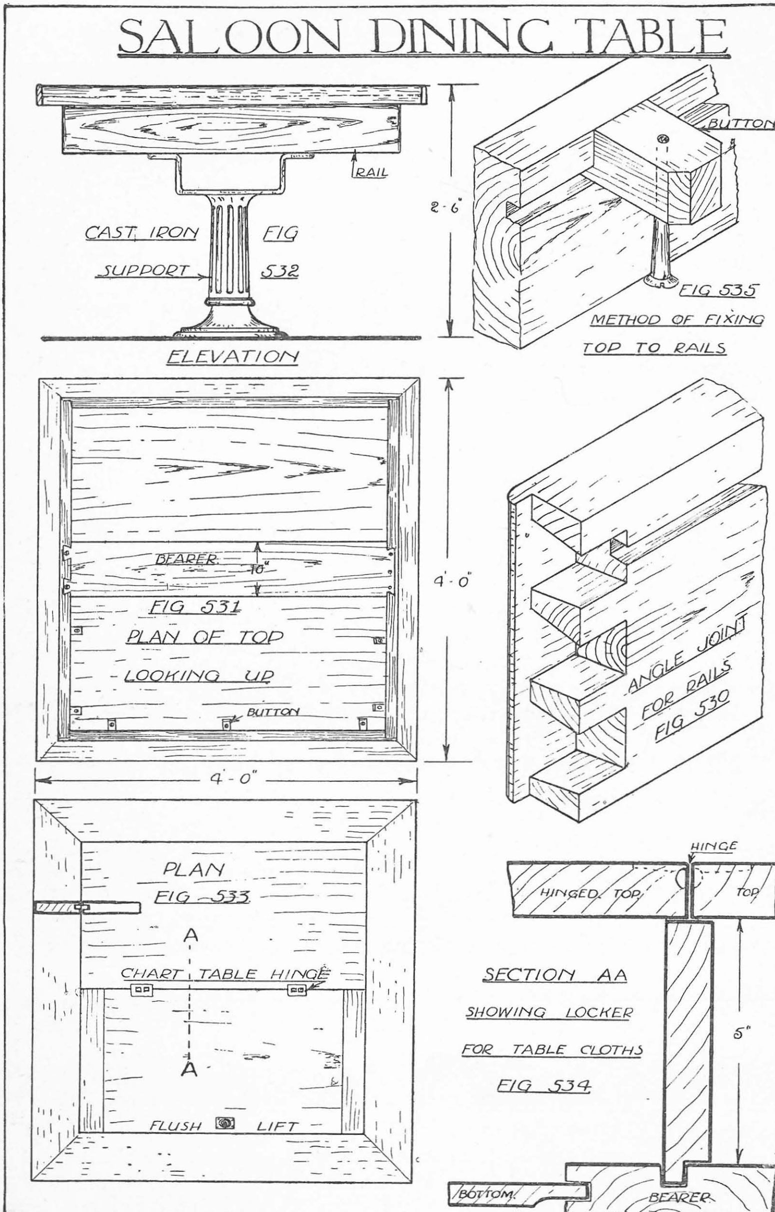
Pedestal: The pedestal part is framed up, each side being made up separately with panel and planting mould. The dado mould is often run with the grain vertical to give it the appearance of a solid block, and the rails of the different frames are veneered with the grain vertical. The pedestal is put together in the shop; only one side is left dry, so as to come apart for subsequent fitting round the stanchion in the ship. The vertical joints at the angles are dowelled; it is usual to cut the two adjacent stiles out of the same piece, so that the similarity in the grain will hide the joint. The *top* is made in two pieces and fitted on the ship. Grounds are used, as shown in section, Fig. 528, and the sides of the pedestal are pocket screwed to same. The shaft, base, and cap are glued, and a *circular steel cramp* is used to hold the joints tight while the glue sets.

Saloon Dining Table.—Dining tables in saloons are being made much smaller than was formerly the custom, chiefly for the purpose of accommodating families, small parties, and passengers occupying the same state-room.

A common type of table is illustrated in Figs. 530 to 535. Cast-iron *stands* instead of ordinary wooden legs are very generally adopted. This stand, though slightly heavier than the wooden ones, is much steadier, and forms a ready means of fixing to the deck.

A special feature of this table is the leaf, part of which is hinged and opens to a *locker*, formed between the rails for the purpose of stowing table-cloths.

The rails are jointed at the angles, as shown in Fig. 530. This joint is very suitable, as the dovetails are entirely hidden, and the small amount of end-grain, which would otherwise be showing, is disguised by rounding off the corner. The rails are 6 in. by $1\frac{1}{4}$ in., and are strengthened across the middle by a *bearer*, which rests on the cast-iron support. Two methods of fixing this bearer to the rails are shown in plan, Fig. 531. One method is by two dovetails, and the other by one large dovetail; the


SALOON DINING TABLE
RAIL
CAST IRON SUPPORT
FIG 532
2 - 6"
ELEVATION
BUTTON
FIG 535
METHOD OF FIXING TOP TO RAILS
BEARER
10"
FIG 531
PLAN OF TOP LOOKING UP
BUTTON
4' - 0"
4' - 0"
ANGLE JOINT FOR RAILS FIG 530
PLAN
FIG 533
A
CHART TABLE HINGE
A
FLUSH LIFT
HINGE
HINGED TOP
TOP
SECTION AA
SHOWING LOCKER FOR TABLE CLOTHS
FIG 534
5"
BOTTOM
BEARER

former joint is the better, and should be glued and screwed in position. In the one half, where the locker is arranged, a bottom is fitted into grooves in the rails and bearer; also to complete the locker, a vertical division is dovetailed into the rails, as seen in section *AA*, Fig. 534.

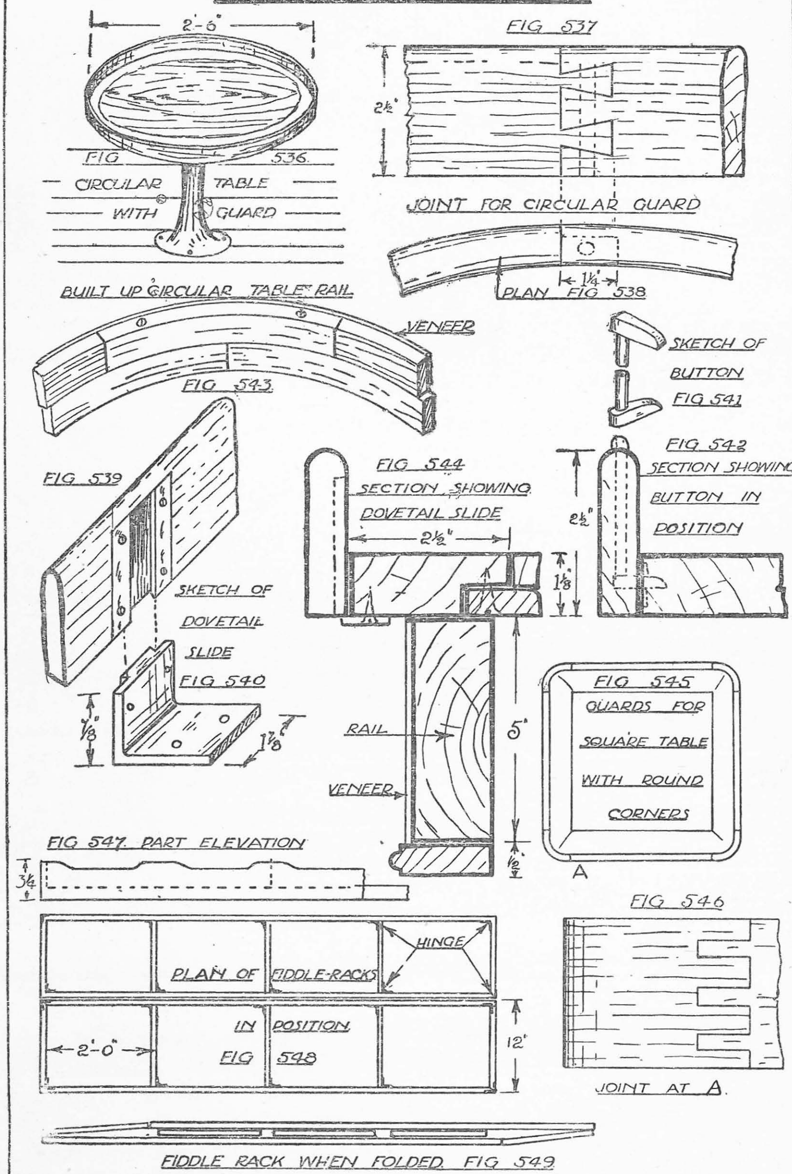
The *leaf* is made up as shown in plan, Fig. 533; the *rims* are dowelled on to the leaf, and a cross-tongue is fitted into plough grooves between the dowels. The angles of the rims are mitred and a cross-tongue is put into the joint. The hinged part of the leaf is clamped at the ends by means of dowels and cross-tongues. The hinges used are flush with the surface of the table when closed; they are similar to the ones used in the chart table. A *ring lift*, which also drops down flush, is sunk into the flap at the opposite edge. The leaf is fixed to the rails by *buttoning*, as shown in sketch, Fig. 535. A *table guard*, which will be explained later, is shown in elevation, but is omitted in the plan.

Table Guards.—These guards are very necessary in stormy weather, or at any time when the ship is rolling. Their purpose is to prevent the various articles from sliding off the table. This is done by a raised lip arranged all round the table leaf. It is, of course, an advantage to have the guards portable, so that they will not be in the way when not required. In third-class accommodation, the dining saloon is also used as a *general room;* and when dinner is over and cloths removed, the tables are used for cards and other games, in which case it is important that the guards should be placed out of the way.

Fig. 536 shows the sketch of a circular table, with the guard in position. This guard, which in section measures $2\frac{1}{2}$ in. by $\frac{3}{4}$ in., is made up in *four parts*, which are jointed together, by dovetail joints, as shown in elevation and plan, Figs. 537 and 538. The dovetails are not seen on the outside, and a $\frac{3}{16}$-in. pin is inserted from the bottom edge; this, together with gluing, makes a strong joint.

When not in use the guard is lowered, so that its upper edge is flush with the leaf of the table; to accomplish this, *brass dovetailed slides* are fitted to the guard, as shown in Fig. 539. These slides fit over a *dovetail stud* fixed to the table leaf, as seen in Fig. 540: four of these studs are fitted to the table, and on these the whole guard can be raised or lowered; but in order to support them in the desired position, *buttons* fixed on a pin at right angles to each other are inserted in the guard at intervals. A sketch of a button is shown in Fig. 541. When the guard is *in use*, the lower button is turned into a *slot* in the edge of leaf, and the upper button rests parallel to, and on, the upper edge of the guard. When the guard is *not in use*, the lower button is turned into a recess in the guard, and the upper button

TABLE GUARDS



rests on the top of the leaf. This should be quite clear on examining the section, Fig. 542.

Fig. 543 shows the building up of table rails for a circular table, and Fig. 544 shows a section through the edge of a circular table. It will be noticed that the leaf is made of two thicknesses of five-ply wood, and the rim is rebated and fixed to same by screwing from the under side.

Figs. 545 and 546 show the jointing of a guard suitable for a **square table** with **rounded corners.**

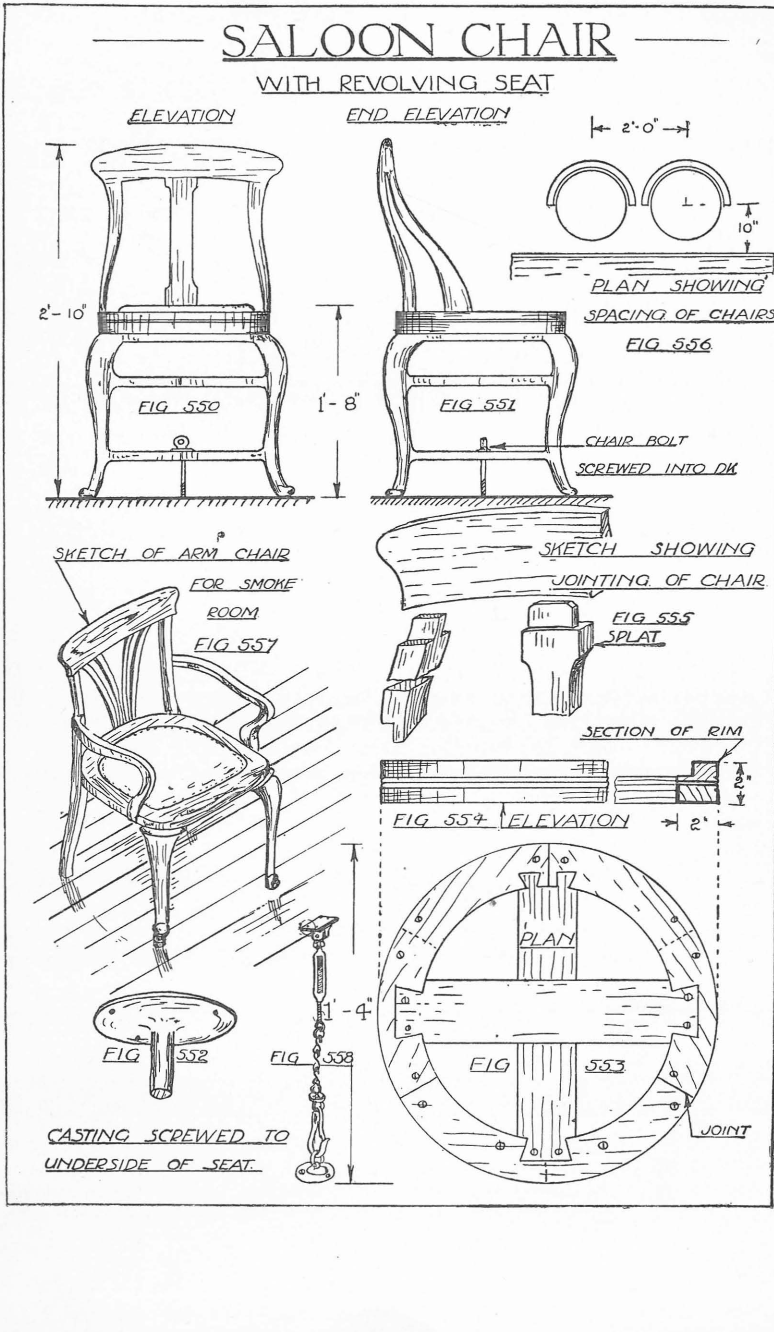
The guards are often termed *fiddle racks,* but this term is probably more used in connection with guards for long tables. The sliding guards for small tables are not so suitable for long tables, on account of their offering no intermediate support for any articles on the table: therefore, guards as shown in Figs. 547 to 549 are adopted. They are partitioned off to give the necessary support, at any part of the table, and can be folded up and stowed against a bulkhead when not in use. The upper edges of the guards are hollowed out opposite each seat, as seen in elevation, Fig. 547. It will be noticed that two of the back flap hinges used on the external angles are on the *outside,* and two are on the *inside;* this allows the guard to be folded up almost flat. The plan, Fig. 549, shows the guard folded up when not in use. The two guards are held together by brass dovetail slides as previously described.

Saloon Chair.—While these chairs are often made by specialist firms, and are sent to the ship ready for fixing, it is important that a knowledge of their construction should be included in dealing with saloon fitments. There are, however, dozens of shapes and designs, and it is only possible to give one or two types, merely to illustrate the construction.

The type of chair largely used is one with a *revolving seat,* which enables the chair to be fixed close to the table, thus saving room, and at the same time making it easy for a person to occupy his chair.

The lower part of the chair is of metal, and is fixed to the deck by a chair bolt. The casting is formed into a circular top, and a circular cast-iron rim having a stud revolves in a socket; to this rim the wood seat is screwed. Figs. 550 and 551 show elevations of the chair, and Fig. 552 shows a sketch of the cast-iron revolving rim.

The *wood seat* is built up in six pieces, as shown in plan and elevation, Figs. 553 and 554; these are glued and screwed together, and the joint between the two thicknesses is hidden by *double beads* run on the spindle after the seat is screwed together. Two *bearers,* halved together, are then jointed to the circular rail. Dovetail joints are used, and where the bearers come opposite a joint in the rim two dovetails are used instead of one.


SALOON CHAIR
WITH REVOLVING SEAT
ELEVATION
END ELEVATION
2'-0"
10"
PLAN SHOWING
SPACING OF CHAIRS
FIG 556
2'-10"
1'-8"
FIG 550
FIG 551
CHAIR BOLT
SCREWED INTO DK
SKETCH OF ARM CHAIR
FOR SMOKE
ROOM
FIG 557
SKETCH SHOWING
JOINTING OF CHAIR
FIG 555
SPLAT
SECTION OF RIM
2"
FIG 554 ELEVATION
2"
PLAN
1'-4"
FIG 552
FIG 558
FIG 553
JOINT
CASTING SCREWED TO
UNDERSIDE OF SEAT

The *back* of the chair is framed up, as shown in Fig. 555, by tenoning together. The *arms* and *splad* are shaped, as seen in the two elevations, so as to be comfortable and to show good curves.

Fig. 556 shows a plan of two chairs, to give the *spacing*, and the distance from the edge of the table to the centre of chair measures 10 in.

Chair for Smoke-room.—A different type of chair, suitable for a smoke-room, is shown in Fig. 557. This chair has arms, and the seat does not revolve. Most of these chairs are fixed to the deck by a chain and swivel, Fig. 558, so that in good weather they can be moved to any desired position.

The *height* of the seat of these chairs is 1 ft. 6 in. from the top of the deck to the top of the seat; and dining chairs have high backs, often up to 3 ft. 3 in. to the top of rail.

Sideboard.—Sideboards form a useful and ornamental part of the dining saloon; the number will depend upon the size of saloon and the number of passengers to be catered for. They are used for the different culinary appliances. The drawers are partitioned off and lined with baize for knives, forks, spoons, etc. The cupboards have bottle trays or wine cellarets, and the table part is fitted with fore-edges or guards. The general arrangement will be seen in elevation, Fig. 559.

The lower carcase has four gables; the two end gables are dovetailed, and the two centre ones are pinned to the top and bottom. The four *pilasters* on the front are sunk to be flush with the rest of the frame. They are fluted and brackets are fixed to support the table part. The table part is given a heavy appearance by planting on a deep mould, seen in section, Fig. 560, the mould being carved to the simple pattern shown. The *fore-edges* are usually silver-plated and are fixed by screws; an alternative section of *fore-edge* sometimes fitted is shown in Fig. 564.

The back is made separate from the ordinary framing. It is fitted with two small cupboards and a large mirror in the centre. The cupboards are fitted with barred doors of a simple design and two small drawers. The cupboard space has a centre shelf with fore-edges.

The *cornice*, which is carried right across on a line with the front of the small cupboards, is ornamented by banding, and the frieze has a simple overlay pattern; an enlarged section of the cornice is shown in Fig. 563.

The panels in the doors of the lower carcase are veneered. The design is known as *quartering;* and to get good results the veneers should all be cut from the same log, and the width

SALOON SIDEBOARD

Fig 559

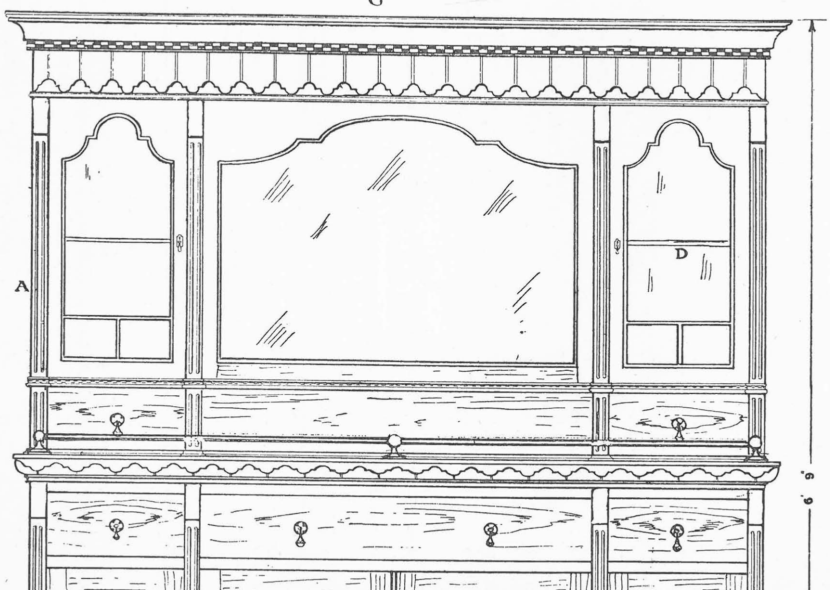
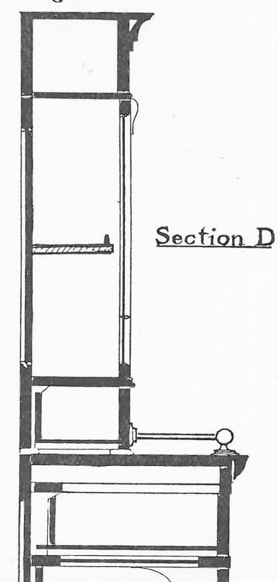
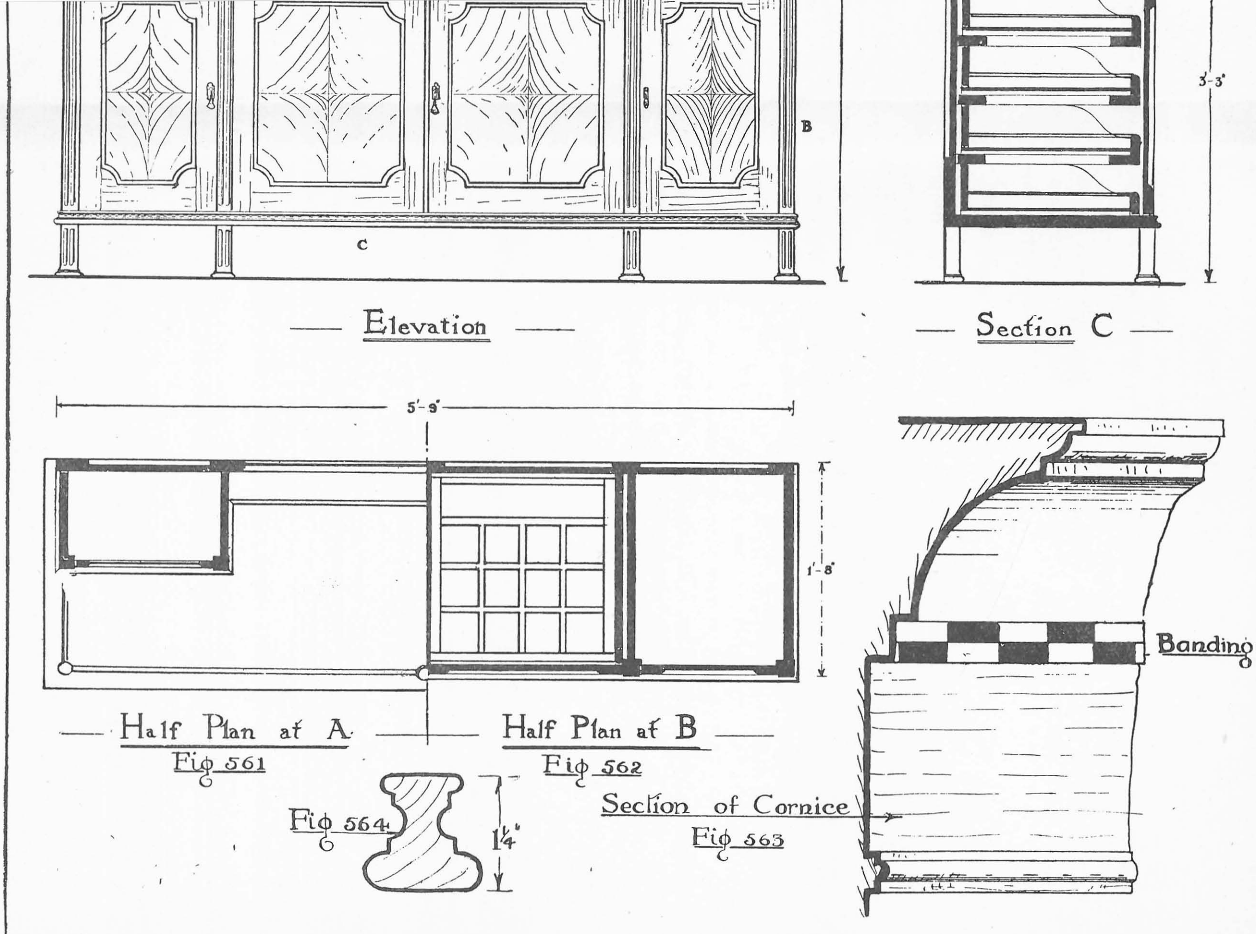


Fig 560



Section D


B
C
Elevation
3'-3"
Section C
5'-9"
1'-8"
Half Plan at A
Fig 561
Half Plan at B
Fig 562
Fig 564
1¼"
Section of Cornice
Fig 563
Banding

and shade of grain should be carefully matched. The veneers are first jointed, and glued to a piece of paper. They are then ready for gluing to the ground. The ground is of mahogany, which should be prepared by toothing with the toothing plane. The veneer is also treated in the same way. Hot glue is coated on the two surfaces, which are held together by a hot caul and handscrews. To prevent the panel from twisting, both sides should be veneered.

Deck Covering.—The decks in dining saloons are very often finished with *parquetry,* that is, thin pieces about $\frac{3}{8}$ in. thick nailed on the deck to some geometrical pattern. The nails are punched below the surface and the wood, usually oak, is polished.

Public Rooms.—The furnishing of smoke-rooms and drawing-rooms is not dealt with in detail as the work is usually sub-let to furniture manufacturers. The framing, however, is usually made in the ship-yard, and is invariably designed to follow period lines—Jacobean and Georgian styles are often selected for dining saloons. Smoke-rooms are often finished with the more interesting details of Louis XV or Empire style; while Adam's, Sheraton, and Chippendale styles gain favour for drawing and ladies' rooms.

CHAPTER XII

STATE-ROOM FURNITURE

PLANNING and Design.—In the planning and design of furniture, the fitments should be made as compact as possible, and the different articles should be made to fold up where space can be saved by so doing. Among the articles arranged to fold up are berths, wash-basins, seats, watch pockets, tumbler holders, sponge baskets, paper racks, linen racks, etc. Other fitments not included in this chapter are berth ladder, hat-and-coat hooks, book shelves, and dressing tables.

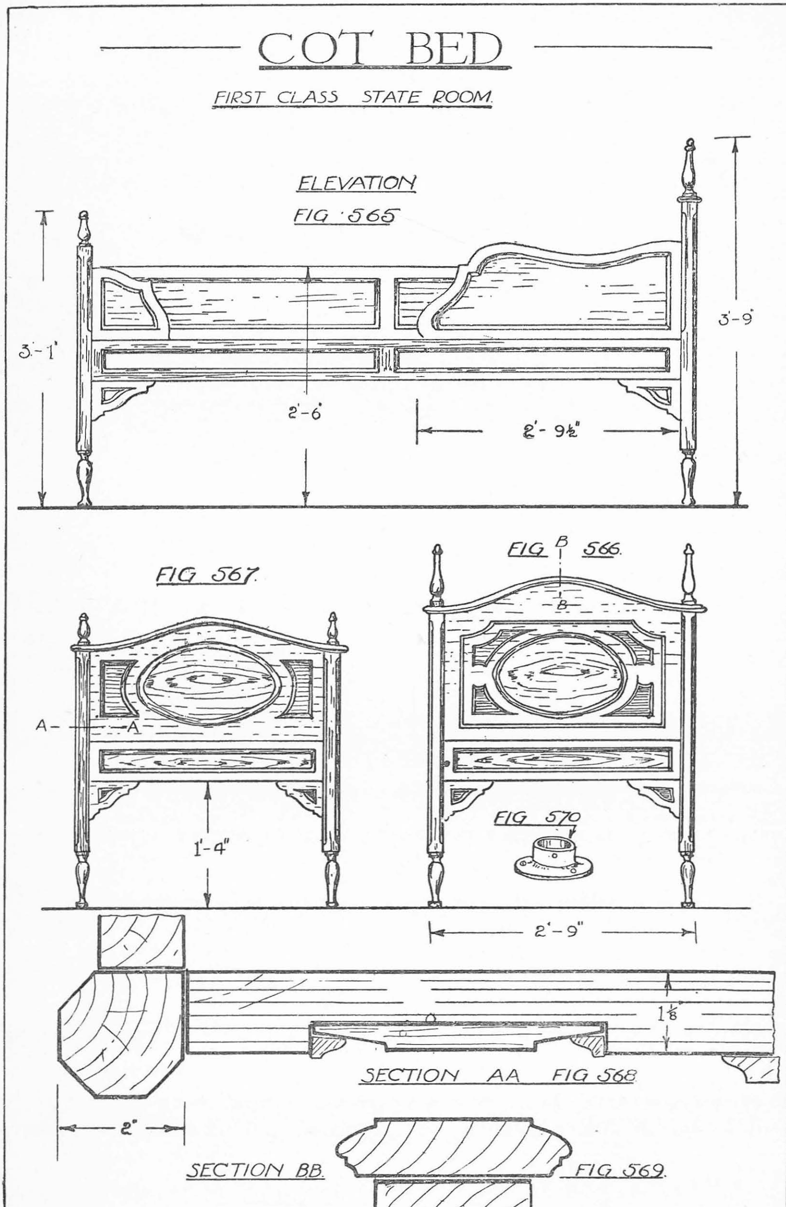
In passenger vessels, where a large number of state-rooms are similar, a "sample room" is often erected and fitted out, so that the designer may be able to submit his ideas to the ship-owner, and be better able to judge of the merits of his design as a whole. Such a sample room provides an easy means of reference for foremen and workmen, if left in position during the fitting out of the ship.

All ship's furniture where not too bulky is made up in a single carcase. There is no necessity for the parts being portable as in house furniture. It may, however, be necessary to make a large piece of furniture in *sections*, in order to get it into position in the ship, as doorways, passages, and stairs are not large; this point should be carefully considered in making large fitments. When in the ship, all the different sections are fixed together, and then secured to the bulkheads and deck.

Different types of state-rooms are shown in the plans, Figs. 498 and 621.

Cot Beds.—The cot bed is seen chiefly in first-class accommodation. In many respects it is similar to an ordinary household bed supported on four legs. These legs are framed to form two ends. The whole of the bed is enclosed by raised sides, or leeboards, which serve the purpose of preventing any movement of the mattress and bed linen when the ship is rolling. The *spring* and *mattress*, which are supported on *lugs* screwed to the ends and side rails, vary in size, according to requirements: for a single bed the spring and mattress are 6 ft. to 6 ft. 3 in. by 2 ft. 6 in.; and for a double bed the same lengths by 3 ft. 6 in. wide. This type of berth takes up considerable deck space, as compared with the "Pullman" and other varieties. The mattress is usually 1 ft. 6 in. from the deck.

The head of the berth is higher than the foot, the heights


COT BED
FIRST CLASS STATE ROOM.
ELEVATION
FIG. 565
3'-1"
2'-6"
2'-9½"
3'-9"
FIG 567.
A— —A
1'-4"
FIG B 566.
B
FIG 570
2'-9"
1⅛"
SECTION AA FIG 568
2"
SECTION BB. FIG 569.

being 3 ft. 9 in. and 3 ft. 1 in. respectively. The *posts* are octagonal in section, with the exception of the inner corner which is kept square to be jointed to the panelled end ; see plan section, Fig. 568. The top and bottom of the posts are turned to some ornamental design.

The end panels are made up of a solid piece, which is sunk to form a design ; a raised panel is planted in the sinking, and a mould is planted around the outline, as shown in section, Fig. 568. The top is covered by a *capping*, as shown in section, Fig. 569, and the moulding on the edge of the capping is carried around the posts. The bottom portion is made into an imitation rectangular panel, by planting on mock stiles and rails. The panelled sides are made in the same way.

A special feature in the design of this bed is the *leeboards*. The far leeboard is made straight and panelled, while the two near ones are cut to an ornamental design. The head leeboard is often hinged to drop down when not in use, and is sometimes fitted with a quadrant to support it horizontally, in which position it may be used as a bed table.

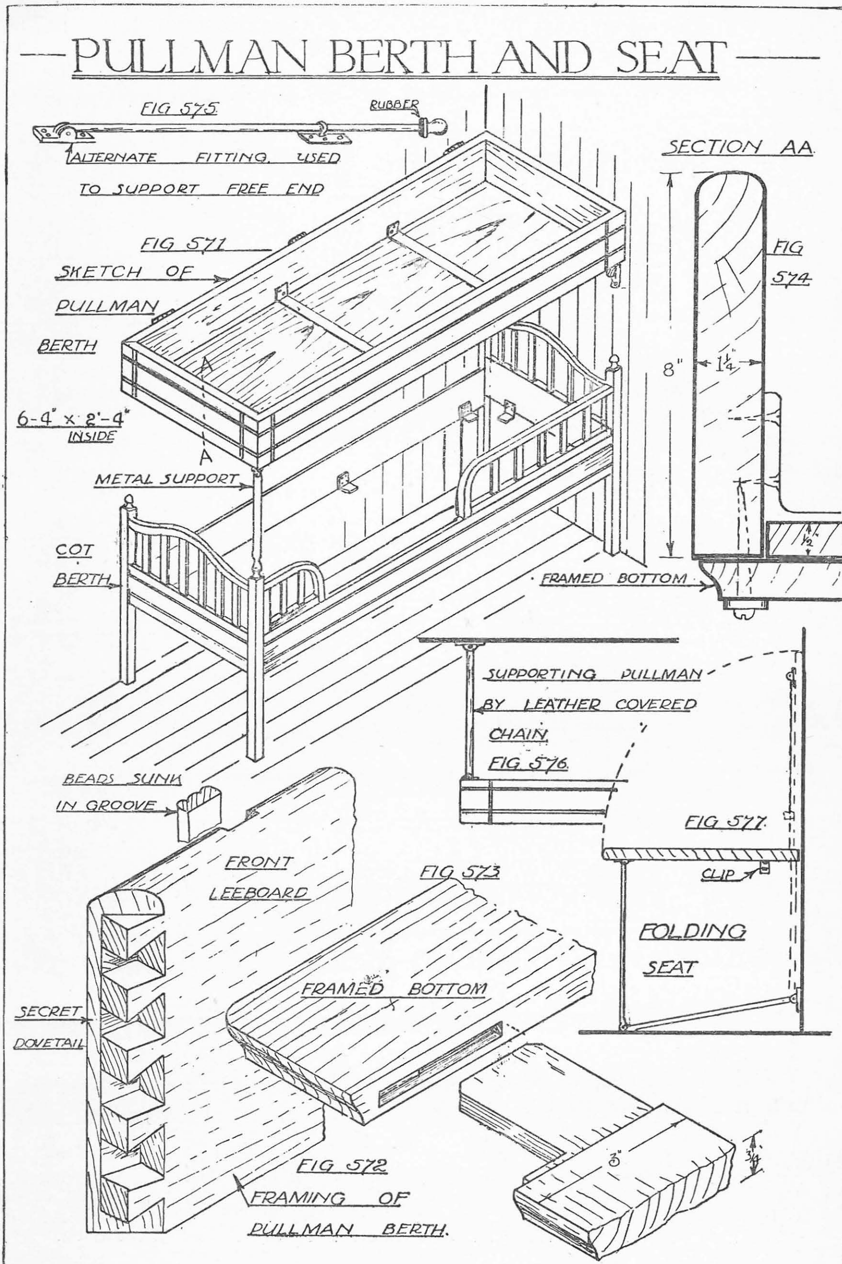
It is held vertically by a flush slip bolt. The whole of the bed is framed up by mortise and tenon joints, and glued together. The angles are often strengthened by screwing brass plates in them. Brackets are fixed between the legs and ends. The ends are tenoned to the legs, and the sides are similarly jointed.

These beds are fixed to the deck by a fitting, as shown in Fig. 570. Wood is used similar to that for the other fittings and may be mahogany, oak, or satinwood.

Ships' berths should, as far as possible, be arranged in a *fore-and-aft direction*, with the *head* of the bed to the *forward end.* There is greater rolling and more movement of the ship in a thwartship direction, hence the lesser dimension of the berth should be placed in this direction.

Pullman Berth.—This type of berth is used in every class of cabin. Its general usefulness, and the small amount of space it occupies, are its chief recommendations. It is usually hung by large *back flap* hinges to the bulkhead, and can be folded back to same when not required. The bed linen can be completely hidden when the berth is folded up against the bulkhead.

Fig. 571 gives a sketch of this berth when in use, and below is seen a cot berth, similar to the one previously described. The berth is made up like a strong box, and every part should be well made and strong, as these berths have to withstand considerable strain. The sides are made from 8 in. to 10 in. deep and $1\frac{1}{4}$ in. thick. The angles are jointed by dovetailing ; the front corners by *secret dovetailing*, as shown in Fig. 572 ; and the back ones by *lapped* dovetailing, which is strengthened by wood


PULLMAN BERTH AND SEAT
FIG 575
RUBBER
ALTERNATE FITTING, USED TO SUPPORT FREE END
SECTION AA
FIG 571
SKETCH OF PULLMAN BERTH
FIG 574
8"
1¼"
6-4" x 2'-4" INSIDE
A
A
METAL SUPPORT
COT BERTH
½"
FRAMED BOTTOM
SUPPORTING PULLMAN BY LEATHER COVERED CHAIN.
FIG 576
BEADS SUNK IN GROOVE
FIG 577
FRONT LEEBOARD
FIG 573
CLIP
FOLDING SEAT
FRAMED BOTTOM
SECRET DOVETAIL
3"
¾"
FIG 572
FRAMING OF PULLMAN BERTH.

screws. The dovetails in the latter case are, of course, hidden against the bulkhead. The sides of the berth, or leeboards, are ornamented in various ways, sometimes by planting mouldings on the surface to imitate panelling, and often, as shown in sketch, by *intersecting beads*. The beads parallel to the grain are run on the solid; and then grooves are cut across the grain, and beads are planted in, as shown in Fig. 572.

The bottom of the berth consists of a frame, made up of two stiles and four rails, and jointed together, as shown in Fig. 573. The moulding is worked on the edge after the frame is completed and it is attached to the leeboards by large washers and screws, as shown in section, Fig. 574. A wide board is then fitted inside, and is screwed to the framed bottom from the inside. Two thin steel bars are fixed to the inside, as shown in Fig. 571, to give additional stiffness to the berth.

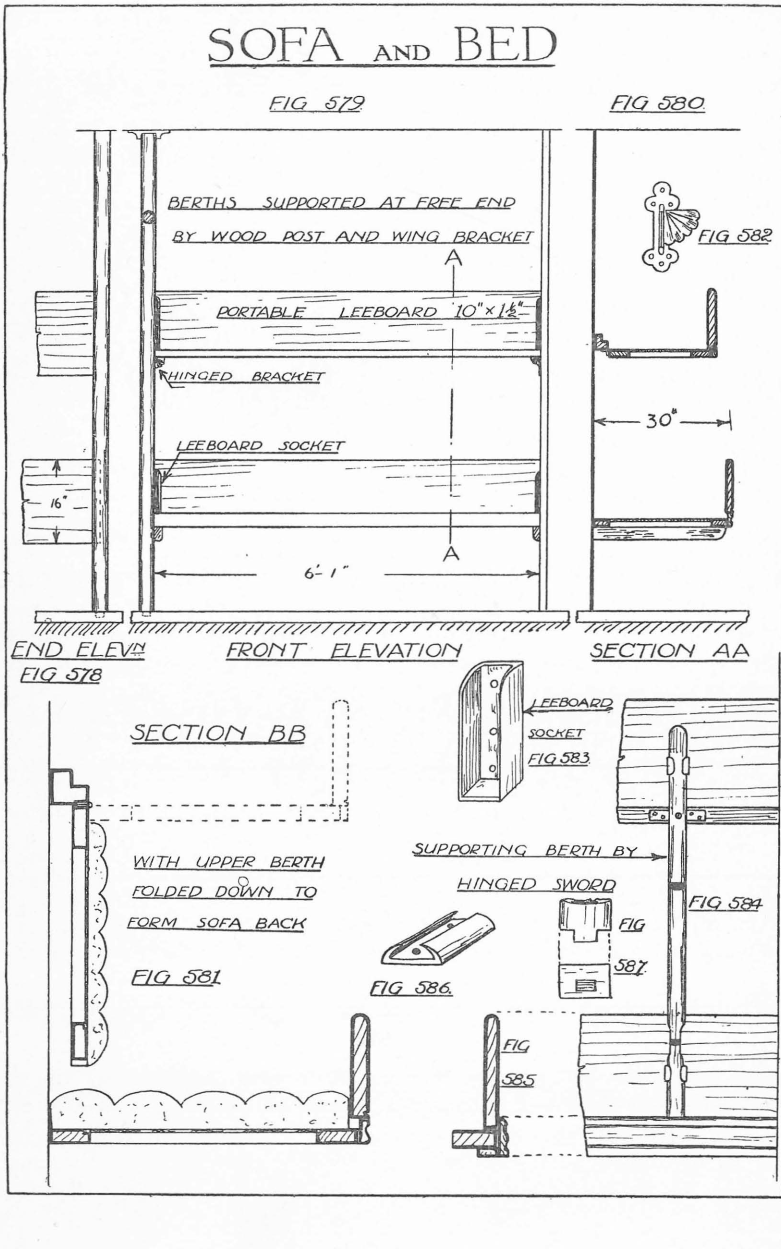
The berth is supported at the outer, or free, edge by a pivoted bracket fixed to the bulkhead, and by a metal support at the opposite end. The metal support, or *sword,* as it is sometimes called, has a socket to fit over the top of bed-post, and is hinged at the top to fold up against the berth when not required. When the berth is not in use, it is held up against the bulkhead by a tower, or slip, bolt pushed into the thwartship bulkhead.

Other methods of supporting the free end of the berth are shown in Figs. 575 and 576. The first method is commonly used both for berths and for folding seats. The flat end-plate is fixed to the bulkhead, and the plate with the sliding ring is secured to the end leeboard. This ring is supported against the rubber stop when the berth is in a horizontal position. Fig. 576 shows the berth suspended by a chain from the deck above; the chain is covered with leather or baize.

Folding Seat.—These seats are placed in state-rooms, bathrooms, etc. They are arranged to fold up against the bulkhead when not in use. A simple arrangement is shown in Fig. 577. A hinged toggle bar rests on the deck when the seat is down as shown, and when the seat is folded against the wall the bar is in a vertical position, being held by a spring clip fixed to the under side of the seat.

Sofa and Bed.—This arrangement converts the berths at night into a sofa to be used in the day. It also often allows of a two-berth cabin to be converted into a four-berth cabin by changing the sofa into berths.

Figs. 579 and 580 illustrate the berths in position for use. The bottom of the lower berth is a fixture, supported by the bulkhead and a listing at one end, and at the other by a circular post and end leeboard. The end leeboard is tenoned into the circular post and fitted into a socket against the bulkhead.


SOFA AND BED
FIG 579
FIG 580
BERTHS SUPPORTED AT FREE END
BY WOOD POST AND WING BRACKET
FIG 582
A
PORTABLE LEEBOARD 10" × 1½"
HINGED BRACKET
30"
LEEBOARD SOCKET
16"
6'-1"
A
END ELEVN
FIG 578
FRONT ELEVATION
SECTION AA
LEEBOARD
SOCKET
FIG 583
SECTION BB
WITH UPPER BERTH
FOLDED DOWN TO
FORM SOFA BACK
FIG 581
SUPPORTING BERTH BY
HINGED SWORD
FIG 584
FIG
587
FIG 586
FIG
585

The bottom is framed up by a mortise-and-tenon joint, and a *spring* is fixed in the frame; over this a portable cushion or mattress is laid.

The upper berth is made in the same way. The front leeboard is portable and drops into metal sockets at each end, and the bottom is supported on *butterfly wing brackets*, as shown in sketch, Fig. 582. The wing revolves, and can be turned round to support the berth; or it can be turned back to allow the bottom to drop down when required to form the sofa back. The end leeboards are not portable. Two different widths of berths are shown: 2 ft. and 2 ft. 6 in. In the case of the upper berth, the leeboard socket is carried by the end leeboard at the left-hand end; while in the lower one, the socket is fixed directly to the circular post.

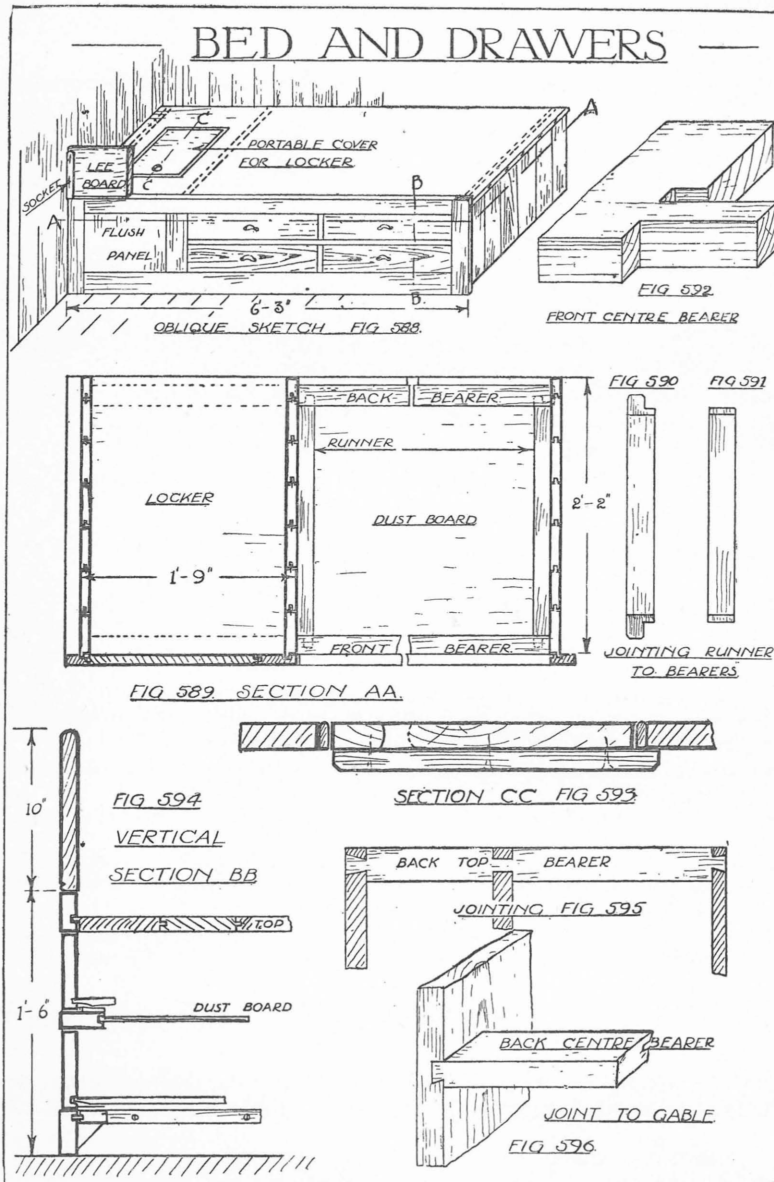
Figs. 584 and 587 show an alternative method of supporting an upper berth between two bulkheads. The lower berth is fixed in the ordinary way, and a sword is provided to support the berth above. The *sword* is a piece of steel pivoted to a stout plate; this plate is fixed to the edge of the berth by screwing. When the berth is in position for use, the lower end rests in a slotted plate, Fig. 587, and the bottom leeboard drops down in position and is held vertical by a metal guide. The sword is made narrower at a little distance above to allow the guide to get a hold on the same; this should be clear from the elevation, Fig. 584. The upper leeboard can be dropped in position by slipping the guide over the end of the sword.

This arrangement is particularly suitable, as the sword holds up the upper berth and at the same time keeps the leeboards quite vertical. When not in use as a berth, the leeboards are stowed into sockets against the back of the berths, and the swords are swung back so as to be flush with the edge of the upper berth, which is dropped down vertically to form the sofa back.

These berths require to be strong. The frame to receive the mattress is made out of 4 in. by $1\frac{1}{2}$ in. pitchpine, and the upper frame is hinged to a stout piece bolted to the bulkhead and rebated to receive the cushion.

Fig. 583 shows a sketch of a leeboard socket.

Bed and Drawers.—Another type of berth has been introduced to economise space. In this case, the space below the berth has been fitted with drawers and a locker, the top of which supports the mattress and bed. A sketch of this arrangement is shown in Fig. 588, in which it is assumed that the right-hand end abuts against some other piece of furniture: hence, a rough spruce gable is shown; also, a flush panel is shown at the opposite end, the front part of which would probably be covered by a seat. From this it will be noted that each piece of furniture must be made to suit other abutting furnishings. The front is of mahogany, while the top and hidden parts are of yellow


BED AND DRAWERS
PORTABLE COVER FOR LOCKER
LEE BOARD
SOCKET
FLUSH PANEL
A
B
C
6'-3"
OBLIQUE SKETCH FIG 588.
FIG 592
FRONT CENTRE BEARER
BACK BEARER
RUNNER
LOCKER
DUST BOARD
1'-9"
2'-2"
FRONT BEARER
FIG 589 SECTION AA.
FIG 590
FIG 591
JOINTING RUNNER TO BEARERS
10"
1'-6"
FIG 594
VERTICAL
SECTION BB
TOP
DUST BOARD
SECTION CC FIG 593
BACK TOP BEARER
JOINTING FIG 595
BACK CENTRE BEARER
JOINT TO GABLE
FIG 596

pine or spruce. The sizes are 6 ft. 3 in. in length and 2 ft. 2 in. in width, and a 10-in. leeboard is dropped into metal sockets at each end.

The plan, section *AA*, Fig. 589, shows the arrangement of *gables* and *vertical divisions,* also bearers, runners, and dust-board between the drawers. Figs. 590 and 591 show two methods of jointing runners to bearers, one by tenoning, and the other by a stub tenon which fits into the dust-board groove. The front centre bearer is jointed to the stiles, as shown in Fig. 592; the tenon goes through and is wedged.

Section *CC*, Fig. 593, shows the method of dealing with the portable cover to locker. The top is glued up first, and the cover is cut out by a pad saw; beads are then planted round the opening and the cover is reduced to the size of opening. *Ledges* are screwed to its under side, and two bearers are screwed under the top, to support the cover. By this method, many otherwise useless corners can be converted into lockers, which are useful for storing articles not much required on the voyage.

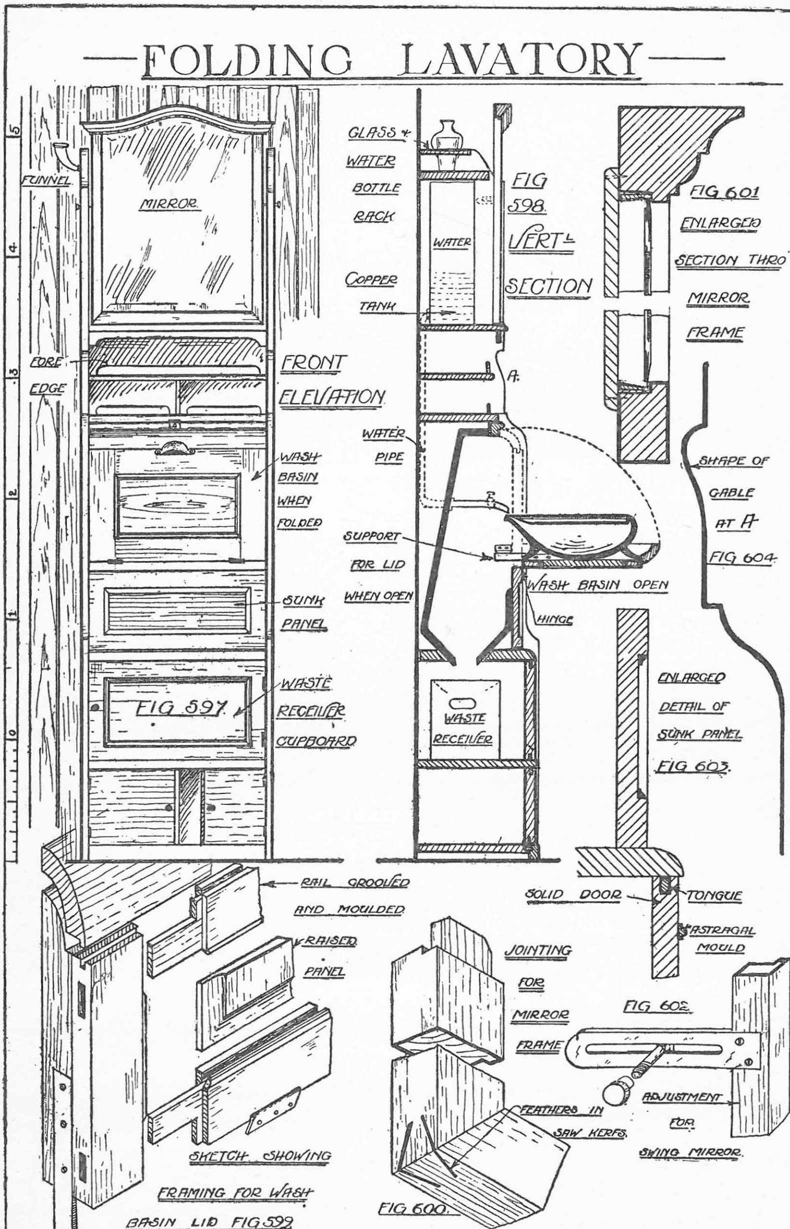
Vertical section, Fig. 594, shows the leeboard in position, a bead breaking the joint between it and the carcase. Fig. 594 also shows sections through the front frame and drawers.

The jointing of the *back top bearer* is shown in Fig. 595; a bridle joint is used at its intersection with the centre gable, and a dovetail joint at the two end gables. The back centre bearer is housed-dovetailed to the gables, as shown in Fig. 596.

Folding Lavatory.—This type of lavatory, Fig. 597, is suitable for one- or two-berth cabins, but for three- or four-berth cabins a *double lavatory* is usually installed. The double lavatory has two wash-basins, receivers, etc.; in fact, from the basin down, it is similar to two single lavatories placed side by side; above that, of course, is different, as one tank is used to supply both basins, and only one mirror is fitted.

This piece of furniture combines in a remarkable degree the useful with the ornamental, and is a very compact and neatly arranged fitment. In some cases the water supply is from a *central storage* and water pipes are laid direct to the basin. The *wash-basin* is fitted inside the hinged flap, and is set in white lead and screwed to same. It has an *anti-splash rim* around its upper edge, and a lip for emptying when being folded. It should be designed so as to be self-cleansing by means of the flush given, when the basin is tipped up. When open, the basin should be well out in front of the carcase, and the length of tap should be arranged to just run the water into the basin. The taps are usually of a self-closing type.

The basins are often of enamelled earthenware, and sometimes of porcelain. The *sluice basin* is also of the same material


FOLDING LAVATORY
FUNNEL
MIRROR
FORE EDGE
FRONT ELEVATION
WASH BASIN WHEN FOLDED
SUNK PANEL
FIG 597
WASTE RECEIVER CUPBOARD
GLASS & WATER BOTTLE RACK
WATER
COPPER TANK
FIG 598 VERT^L SECTION
A
WATER PIPE
SUPPORT FOR LID WHEN OPEN
WASH BASIN OPEN
HINGE
WASTE RECEIVER
FIG 601 ENLARGED SECTION THRO' MIRROR FRAME
SHAPE OF GABLE AT A FIG 604
ENLARGED DETAIL OF SUNK PANEL FIG 603
SOLID DOOR
TONGUE
ASTRAGAL MOULD
RAIL GROOVED AND MOULDED
RAISED PANEL
SKETCH SHOWING FRAMING FOR WASH BASIN LID FIG 599
JOINTING FOR MIRROR FRAME
FEATHERS IN SAW KERFS
FIG 600
FIG 602
ADJUSTMENT FOR SWING MIRROR

and is fitted with soap trays. The sluice basin should have no sharp corners and as far as possible be self-cleansing. In some cases, the sluice basin is omitted, and the inside of the carcase is tapered off to direct the water into the waste receiver underneath; in this instance the woodwork should be made watertight. These details should be clear on examining Fig. 598.

The tip-up basin and flap are supported horizontally by a stout piece of iron screwed to same, and by a *knee-piece* screwed to the inside of the carcase. Brass quadrant stays are sometimes used for this purpose; see also Fig. 598.

The fresh water supply is stored in a copper tank in the upper part of the lavatory. It is connected to the basin by a small pipe and tap, and the tank is filled through a small funnel entering the side of the carcase. The mirror hides the tank from view. Above the tank a shelf is framed to the gables, and at a short distance above that is a small perforated rack to hold a water bottle and glass.

The small cupboard underneath the sluice basin contains the *waste receiver*. It should be fitted with an anti-splash rim, and should be of the same capacity as the tank, so as to prevent flooding.

These lavatories are made of the same wood as the other state-room fittings, and are often of mahogany or satinwood; the hidden parts are of yellow pine. The gables are prepared and cut to shape, and the horizontal divisions are housed to them. The small doors in front are often solid, and are strengthened by inserting a slip in a plough groove across the end wood. Moulding is often planted on the face, to imitate a panel. If the doors are large they should, of course, be properly framed together. Brass hinges are used, and Bale's catches are fitted to hold the doors when closed.

The flap of the basin requires to be strongly made on account of the weight of the basin; Fig. 599 shows the construction. The panel is raised and fielded, and side pieces are screwed to the flap, to which the supports are fastened.

The small *lockers* above—for towels, etc.—are fitted with fore-edges, which are rounded on their upper edges, and are fixed by screwing from underneath.

The *mirror frame* is tenoned at the top, and mitred at the bottom; the reason for mitring is that the face of the frame is often moulded, and two slips are inserted in saw-kerfs, dovetail fashion, to give extra strength to the joint; this is shown in Fig. 600.

The *water bottle rack* is arranged to have an upper shelf cut to receive the glasses and bottle. This shelf, which is not more than $\frac{1}{2}$ in. thick, has the holes pierced through by a *cutter bar* in a drilling machine. On board ship, quite a number of similar

WASH BASIN STAND

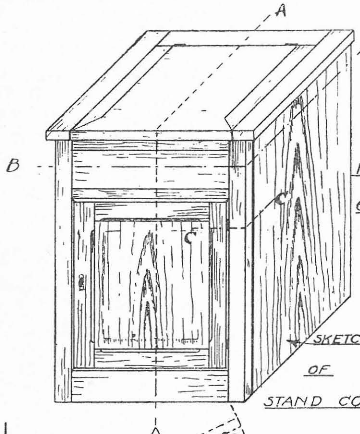
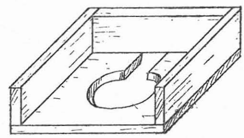


FIG 605

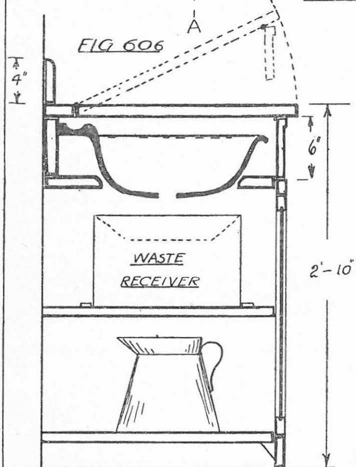
SKETCH OF STAND COMPLETE.



SKETCH OF BASIN TRAY

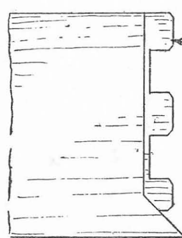
FIG 608

FIG 606



VERT^L SECTION AA

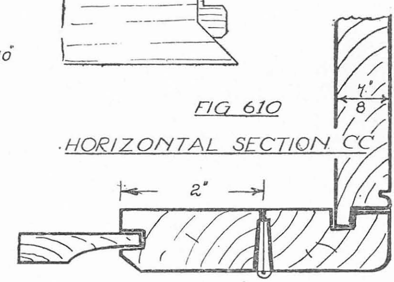
FIG 609

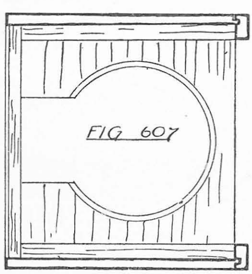


JOINT FOR CLAMP ON END OF FLAP

FIG 610

HORIZONTAL SECTION CC





PLAN SECTION BB

FIG 611

Cutting List

Wash Basin Stand. Boat No 669.

Front Frame	2	3'-0"	2¼"	1"	Canarywood
" "	1	2'-1"	1½"	1"	— D° —
" "	1	2'-1"	4½"	1"	— D° —
Door	2	3'-8"	2½"	1"	— D° —
Gables	2	2'-10	2'-0"	⅞"	— D° —
Top.	3	2'-1"	3¼"	1"	— D° —
Flap	2	1'-10"	2¼"	1"	— D° —
"	1	1'-10"	1'-10"	1"	— D° —
"	1	1-10"	6½"	1"	— D° —
Tray	3	2'-0"	5¼	1	— D° —
"	1	2-0	2-0	1"	— D° —
Skirting	1	2-1"	4¼"	⅝"	— D° —
Shelves	2	2-0	2-0	¾	Y Pine.

racks are required for glasses, crockery, etc., which require to be portable, and at the same time require to be kept firmly in place.

Figs. 601 and 602 give further details of the mirror frame. The former shows the slot-and-screw adjustment to tilt the mirror, and the latter shows a section of the mirror. It will be noted that the glass is held in by tapered *centering slips*, which allow of the mitres on the bevelled glass being adjusted to come directly opposite the mitres on the wood frame.

Wash-basin Stand.—An alternative type to the folding lavatory previously described is the wash stand, chiefly used in third-class accommodation and seamen's quarters.

A sketch of the stand complete is shown in Fig. 605. The lower portion is formed into a cupboard having shelves to hold the waste receiver and water jug. The upper part has a double flap arranged to cover the basin when not in use.

Fig. 606 is a vertical section at *AA* and shows this arrangement clearly. The *flap* covering the basin is hinged in two parts, top and front, and folds up against the bulkhead. The top is framed up by two clamps, jointed as shown in Fig. 609; the front of the clamp is mitred so as not to show end-grain. The front portion of the flap is sunk to imitate a top rail. A small frame is fixed to the carcase, for purposes of fitting, and to form a means of hanging the top.

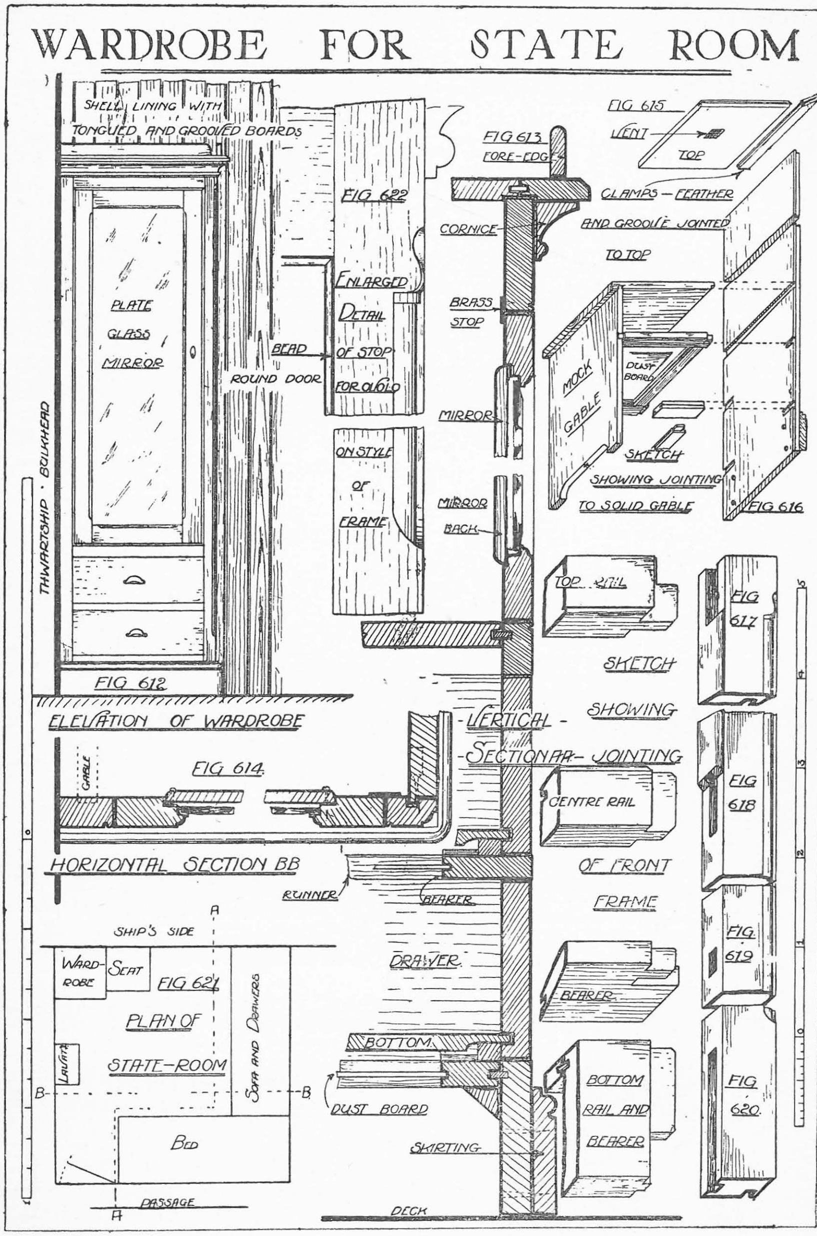
The porcelain *basin* is fitted and fixed into a *tray*, a sketch of which is shown in Fig. 608. The corners are dovetailed, and the bottom is screwed to the sides and the back. The whole of the joints should be made watertight by coating with white lead. The tray is supported on listings screwed to the gables. A plan of the tray is shown in position in Fig. 607.

Two shelves are housed-dovetailed to the gables. The top shelf holds the waste receiver, which should be fixed directly under the basin by screwing small slips on to the shelf. The bottom shelf is used for the water jug, which is usually of zinc.

The front frame is jointed to the gables by a tongue-and-groove joint, as seen in Fig. 610. The door has a raised panel and is hinged to the front frame. It is hung with brass butts, and a spring catch is attached to the striking stile.

It often happens that the joiner has to prepare a *cutting list* for fitments he is called upon to make, and in order to show how this is done a typical cutting list is illustrated in Fig. 611. It is divided into the number of columns required, and the rough or *saw cutting sizes* are given. In the first column is given the name of the part; the second, the number of pieces; the third, fourth, and fifth, the sizes; and the sixth, the kind of wood. The parts showing are of canary wood (stained), and the hidden parts are of yellow pine.

On one side of the wash stand, a mirror is often secured to the


WARDROBE FOR STATE ROOM
SHELF LINING WITH TONGUED AND GROOVED BOARDS
PLATE GLASS MIRROR
THWARTSHIP · BULKHEAD
FIG 612
ELEVATION OF WARDROBE
FIG 622
ENLARGED DETAIL OF STOP FOR OLOLO
ON STYLE OF FRAME
BEAD
ROUND DOOR
FIG 613
FORE-EDGE
CORNICE
BRASS STOP
MIRROR
MIRROR BACK
FIG 615
VENT
TOP
CLAMPS — FEATHER AND GROOVE JOINTED TO TOP
MOCK GABLE
DUST BOARD
SKETCH SHOWING JOINTING TO SOLID GABLE
FIG 616
TOP RAIL
FIG 617
SKETCH SHOWING JOINTING OF FRONT FRAME
-VERTICAL- -SECTIONAL-
CENTRE RAIL
FIG 618
FIG 619
BEARER
BOTTOM RAIL AND BEARER
FIG 620
GABLE
FIG 614
HORIZONTAL SECTION BB
RUNNER
BEARER
DRAWER
BOTTOM
DUST BOARD
SKIRTING
DECK
SHIP'S SIDE
WARD-ROBE
SEAT
FIG 621
PLAN OF STATE-ROOM
LAVATY
SOFA AND DRAWERS
BED
PASSAGE
A
B

bulkhead, and on the other side of the stand a toilet rack is fixed.

Wardrobe for State-room.—This wardrobe is fully illustrated in Figs. 612 to 622. The bulkhead and ship's side form two of its sides. If the bulkheads were panelled instead of sheeted, the panel would be of the flush type and one of the muntins would be arranged to suit the size of the wardrobe.

Before proceeding with the making of the wardrobe, it will be necessary to have the bevels—both fore-and-aft and thwartship. A skeleton would only be necessary in case of it being fitted around a ventilating shaft or other obstacle.

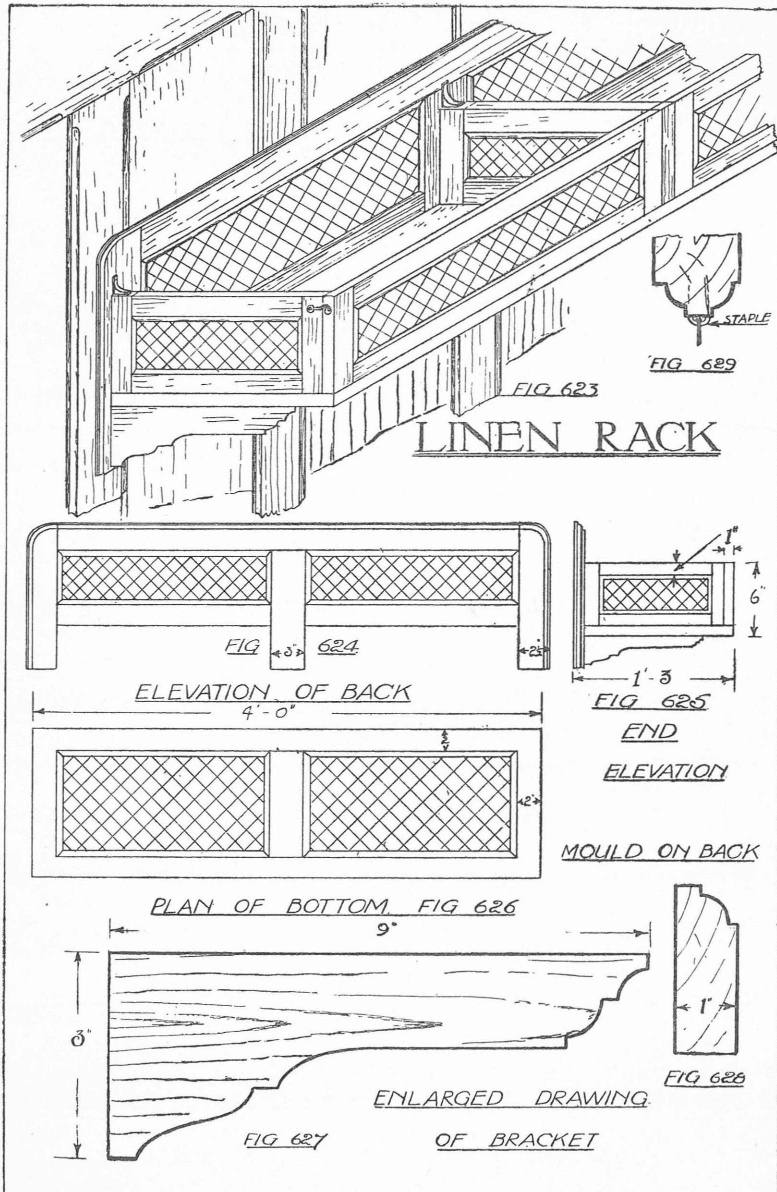
The wardrobe shown is composed of a space for hanging clothes, and two drawers underneath. The top is also utilised for sundry articles, and to prevent such articles from falling off a fore-edge is fitted on the two open sides of the top. The general arrangement will be seen in elevation, Fig. 612. In larger state-rooms *double wardrobes* are fitted, which would be practically the same as placing two of the wardrobes shown side by side; it would have two hanging spaces and four drawers.

The chief parts of the carcase are a solid gable, front frame, and top. The top is of canary wood with mahogany clamps fixed to the edges by a cross-tongue and groove; the angles of the clamps are mitred and a short cross-tongue is placed in the mitre. The gable and front frame are housed into the top, and a hole is bored in the latter to form a vent, which has a wire gauze covering; see Fig. 615. The fore-edges add to the appearance of the wardrobe; they are fixed by screwing from the under side.

The gable and front frame are fixed together by a tongue-and-groove joint, and are pocket screwed from the inside. The pockets are cut square and are afterwards filled in flush; see section, Fig. 614. A moulded skirting is carried round the bottom of the carcase, being fixed by gluing and screwing from the inside; the angle is formed with a plain butt joint, and the corner is rounded off. In cases where the furniture is "made square," the skirting is scribed and fixed in the ship.

The front *drawer bearers* are faced up with ½-in. facing, and the remainder of the bearers are of yellow pine. The drawer *runners* are often of oak on account of its hard-wearing qualities. The joints are shown in Figs. 619 and 620; the centre bearer is tenoned to the front frame and housed to the gable; the bottom bearer is housed to the gable and jointed by feather-and-groove and glue blocks to the bottom rail.

The jointing for the front frame is clearly shown in Figs. 617 to 620, and the bead which is carried around the door is mitred at the angles. The tenons into the stile next to the door go right through and are wedged, but those into the outer stile


STAPLE
FIG 629
FIG 623
LINEN RACK
1"
6"
FIG 3" 624
2"
1'-3
FIG 625
END
ELEVATION
ELEVATION OF BACK
4'-0"
2"
2"
MOULD ON BACK
PLAN OF BOTTOM FIG 626
9"
3"
1"
FIG 628
ENLARGED DRAWING
FIG 627
OF BRACKET

do not go through and are glued and screwed from the inside. The general arrangement of the lower portion of the carcase is shown in Fig. 615. Below the centre shelf a mock gable is fitted; this enables the drawers to be fitted in the shop.

A cornice mould is mitred round the top; it is glued and screwed from the inside. On the outer stile of the front frame, an ovolo mould is worked; a special feature of this mould is the "stops," shown enlarged in Fig. 613.

The door is mortised and tenoned together, and the stuff is stop moulded and double rebated for mirror and back. It is hung with brass or silver-plated butt hinges, and two brass stops are fixed at the angles of the striking stile.

Linen Rack.—The linen rack is a specially useful fitment in the state-room, and it is usually fixed to the bulkhead directly above a berth. It is made as light as possible and is ornamented to suit the other furnishings. Linen racks are made in the workshop and are *standardised* in *parts:* for example, the backs are made complete to size and bevel, and are polished; similarly the front bottom and ends; they are then fixed together.

The frames are all mortised and tenoned together, all the tenons being stopped so as not to show end-grain. An ovolo mould is run around the inner edge, seen in section, Fig. 629; and small brass *staples*, through which the cord is threaded, are driven into the edges at definite intervals. The cord is, of course, inserted after the frames are polished; it forms a light and decorative panel.

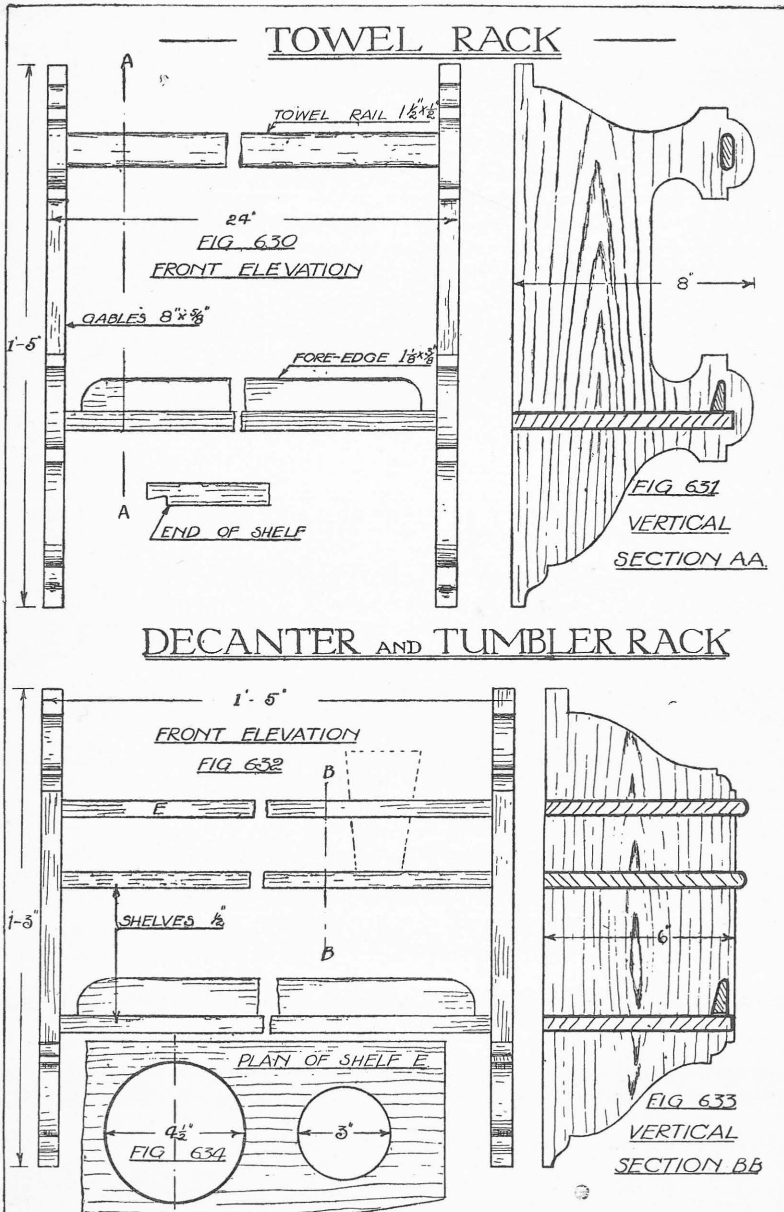
Fig. 623 shows a sketch of the rack when in position. Its total length is 4 ft., and the width overall 15 in. There are two compartments (only one and part of the other is shown in the sketch), and the fronts are hinged so as to drop down.

The bottom of the rack is screwed to the back, and is supported at right angles by three ornamental brackets, as shown in Fig. 627. The ends of the rack are fixed by screwing through the bottom and back, and additional strength is supplied by a small metal bracket screwed to back and end.

The *front flaps* are hinged to the base, and when closed are held by a hook and eye to the end, and by a Bale catch to the centre division.

The drawings, Figs. 624 to 626, show the different views of the rack, and the general sizes are given. A section of the mould on the back is given in Fig. 628.

Towel Rack.—These racks are used in combination with wash-basins, and are fixed to the bulkhead near to the basins. A shelf is arranged, and is fitted with a fore-edge on which the clean folded towels are placed; directly above a rail is fitted on which the wet towel can be hung; see elevation, Fig. 630.


TOWEL RACK
A
TOWEL RAIL 1½"x1½"
24"
FIG 630
FRONT ELEVATION
GABLES 8"x⅝"
1'-5"
FORE-EDGE 1⅛"x⅜"
A
END OF SHELF
8"
FIG 631
VERTICAL
SECTION AA.
DECANTER AND TUMBLER RACK
1'-5"
FRONT ELEVATION
FIG 632
B
E
1'-3"
SHELVES ½"
B
PLAN OF SHELF E.
4½"
FIG 634
3"
6"
FIG 633
VERTICAL
SECTION BB

The gables are of some ornamental design like the one shown in end elevation, Fig. 631. It is, however, better in designing curved work of this kind to have simple curves, which can be cut on the band saw and finished on the spindle. The gables are $\frac{5}{8}$ in. in thickness, and the shelf is housed-dovetailed to them. The fore-edge is stopped short at the ends and rounded off; it is secured by screwing from underneath. The section of towel rail is shown in Fig. 631; it is fixed by housing and gluing the ends to a depth of $\frac{3}{8}$ in. into the gables. These racks are often made in polished oak or mahogany, and the polishing is done while the rack is in parts; of course, they also require to be finished a little after they are fitted together.

The rack is screwed to the bulkhead by means of brass or nickel-plated snap-head screws.

Decanter and Tumbler Rack.—This rack is illustrated in elevation, section, and plan of shelf, in Figs. 632 to 634. It is employed in many parts of the ship—state-rooms, lavatories, dining saloon, smoke-rooms, etc. It holds a decanter and two glasses, which should be kept steady in position.

The rack is made up of two gables and three shelves, which are housed-dovetailed together. The lower shelf is fitted with a fore-edge and is used for sundry articles. The two upper shelves are rounded on the front, as seen in plan, Fig. 634. The centre shelf is plain and is used to support the glasses in position, while the upper shelf is pierced with holes to receive the glasses. A hole of $4\frac{1}{2}$ in. diameter is shown for the decanter, and 3 in. diameter for the glasses; these holes are cut by a special bit in a drilling machine.

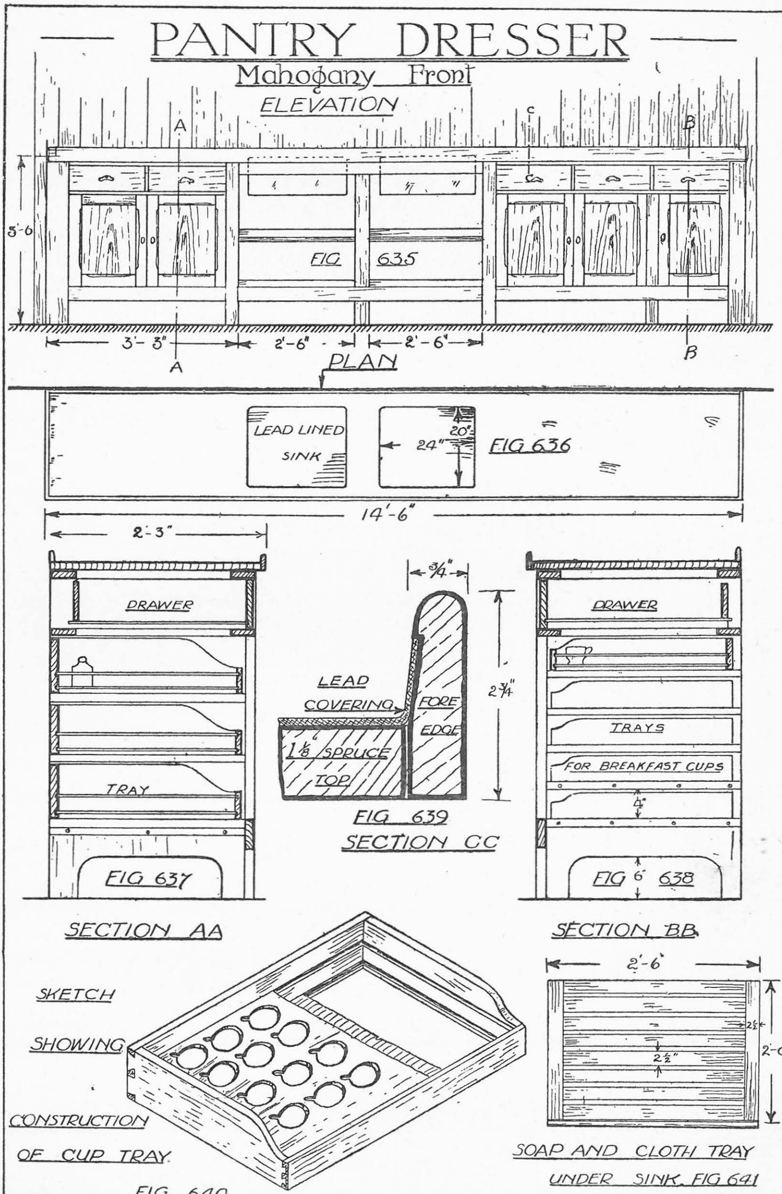
In a modern ship a large number of these racks are required, and the work is standardised to facilitate quick production.

CHAPTER XIII

PANTRY FITMENTS AND SEAMEN'S QUARTERS

PANTRY Dresser.—Pantry dressers are made in many sizes, and most of them are fixed against a bulkhead; some, however, are fixed to the deck in the middle of the pantry and are known as *island* dressers. The one shown is fixed against a thwartship bulkhead. For convenience of handling it is made up in three carcases: one to the *left* with two cupboards and two drawers; one to the *right* with three cupboards and three drawers; and the *space between* is fitted with sinks, and shelves below; see Fig. 635. The top is in one piece, with holes cut in to receive the *sinks;* see Fig. 636. In cases where the top is used for washing crockery, etc., it should be watertight: hence the one shown is covered with lead. Zinc is sometimes used for the same purpose. The fore-edge is rebated to receive the edge of the lead, as shown in section *CC*, Fig. 639. This covering, however, is often omitted, and a stout piece of birch, $1\frac{1}{4}$ in. thick, is used for the top; while this is fairly proof against cracks, and may be perfectly sound when leaving port, it would in all probability split before being very long in use and allow the water to percolate into the drawers and carcase below. An ordinary wood top without covering is satisfactory in cases where sinks are not required, and where there would consequently be very little moisture.

Carcases: The carcases are made up in the usual way of two *solid gables* and a *front frame.* The section *AA*, Fig. 637, shows the general arrangement of bearers and runners. The cupboard space is sometimes fitted with shelves, but more often with *trays.* These trays are used for cups, small bottles, bread and butter, etc. They are made to slide in the same manner as a drawer. The construction of one of these trays is shown in Fig. 640. It is made to carry breakfast cups. The centre shelf is perforated to receive the cups, which should rest on the bottom and be quite steady when in position. Where these trays slide in fore-and-aft directions, the runners can be horizontal; but where they slide athwartship, the runners are made to slope down to the back at an angle of about 15°. The reason for this is that when the ship is rolling the amount of *list* is greatest athwartship, and the rolling would tend to throw out the trays as soon as the doors were opened; the sloping of the runners


PANTRY DRESSER
Mahogany Front
ELEVATION
A
C
B
3'-6
FIG 635
3'-3"
2'-6"
2'-6"
A
B
PLAN
LEAD LINED
SINK
20"
24"
FIG 636
14'-6"
2'-3"
DRAWER
TRAY
FIG 637
SECTION AA
3/4"
LEAD
COVERING
FORE
EDGE
1 1/8" SPRUCE
TOP
2 3/4"
FIG 639
SECTION CC
DRAWER
TRAYS
FOR BREAKFAST CUPS
4"
6"
FIG 638
SECTION BB
SKETCH
SHOWING
CONSTRUCTION
OF CUP TRAY
FIG 640
2'-6"
2 1/2"
2 1/2"
2'-0"
SOAP AND CLOTH TRAY
UNDER SINK. FIG 641

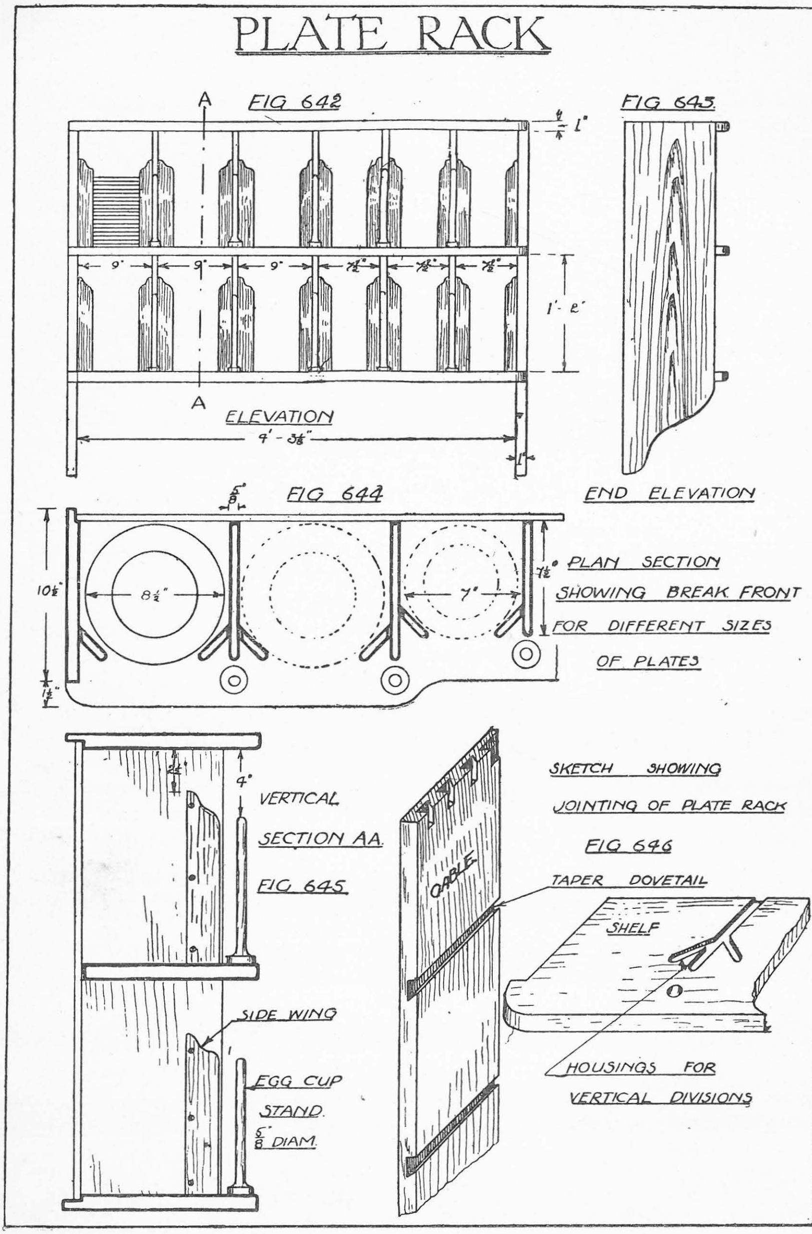


PLATE RACK
A
FIG 642
A
ELEVATION
4' - 3⅛"
1'- 2"
FIG 643
END ELEVATION
FIG 644
PLAN SECTION
SHOWING BREAK FRONT
FOR DIFFERENT SIZES
OF PLATES
VERTICAL
SECTION AA
FIG 645
SIDE WING
EGG CUP
STAND
5/8" DIAM.
GABLE
SKETCH SHOWING
JOINTING OF PLATE RACK
FIG 646
TAPER DOVETAIL
SHELF
HOUSINGS FOR
VERTICAL DIVISIONS

prevents the trays from sliding out. There is, of course, the same tendency when the trays slide fore and aft, but in a lesser degree, and the runner may be placed horizontally.

In some cases, the doors in front of the trays are omitted and a *hinged slip*, fitted with a lock, holds in the trays. This method does not keep the contents so free from dust as when doors are provided.

The trays are made similarly to a drawer, only that the front is kept lower and the sides are rounded off to suit. Two grooves are made to receive the double bottom, which is made out of three-ply wood. The bottoms are fitted in prior to gluing up.

Shelves and Sink: Four shelves are placed under the sink and are framed up, as shown in Fig. 641, with a fore-edge at the front.

The sinks are dovetailed together and are of *teak*. The inside is lined with lead, fixed by copper tacks.

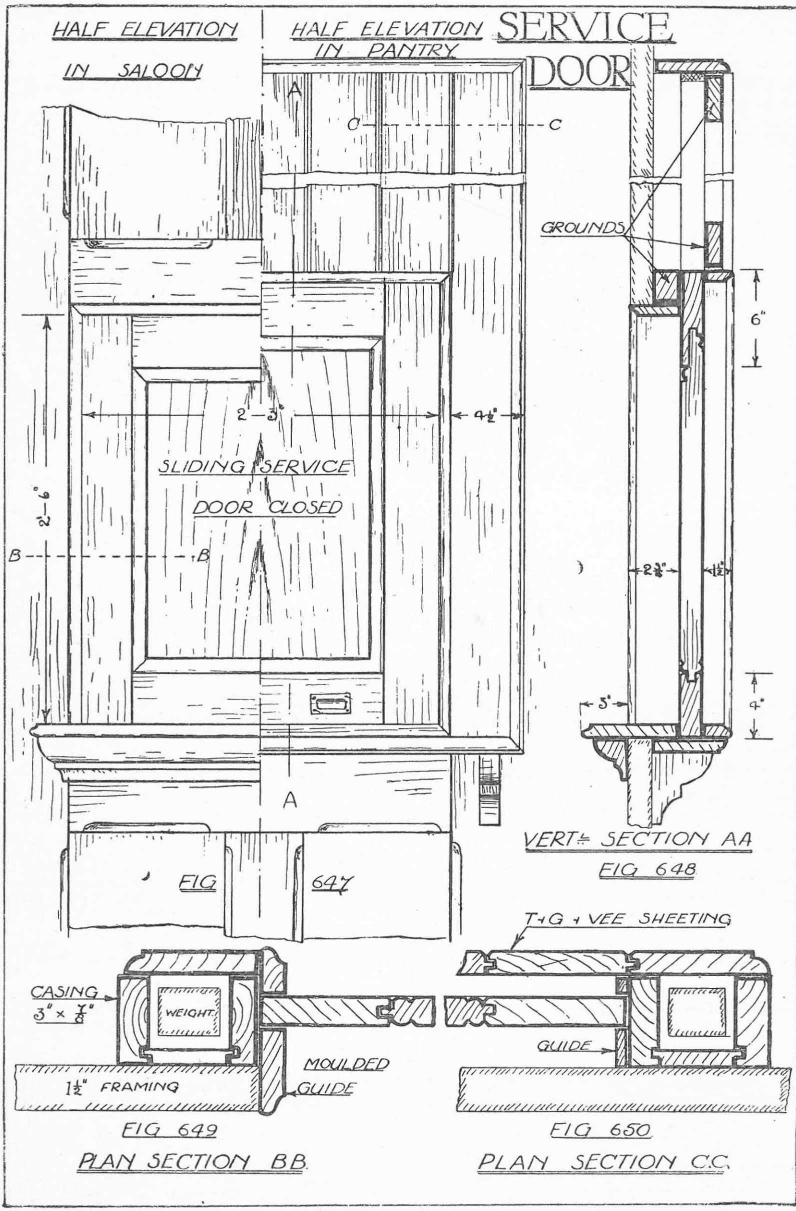
In good work these dressers have mahogany fronts, but in many cases *canary wood*, stained to imitate mahogany, is used. The fore-edges are dovetailed at the angles and are carried all round the top.

A common way of carrying cups is to hang them up on *cup hooks*. The cup hooks are fixed into a batten attached to the deck above.

Plate Rack.—The necessity for some means of holding plates steady and convenient for use has produced the rack shown in Figs. 642 to 646. The rack is also used for egg-cups, and in many cases carries *wine glasses* as well in a shelf slotted to receive same. Plates are of various sizes, hence it is important to have the exact size of plates in designing such a rack. The one shown will carry large and small dinner plates of $8\frac{1}{2}$ in. and 7 in. diameter, respectively; of course, a small amount of clearance is necessary to enable the plates to be easily dropped into place, and $\frac{1}{4}$ in. is allowed all round the plate. The plates are supported on three sides by *two vertical divisions* and the *back;* and, while the front must be left open in order to remove the plates, *side wings* are fixed to the vertical divisions to prevent the plates from falling out.

The front and end elevations, Figs. 642 and 643, show the general arrangement and sizes of the rack, and in the top left-hand division the plates are shown in position. To remove a plate it is simply raised up above the side wings and drawn out.

The plan, Fig. 644, shows the plates in position; it also shows the *break front* to suit the different sizes of plates, allowing $\frac{1}{2}$ in. in height for each plate. Each division holds comfortably about 20 plates. In the plan will also be seen the egg-cup stands directly in front of the vertical divisions; they are turned in the lathe and are made $\frac{5}{8}$ in. diameter to suit the hole through


HALF ELEVATION IN SALOON
HALF ELEVATION IN PANTRY
SERVICE DOOR
A
C
C
GROUNDS
6"
2—3"
4½"
SLIDING SERVICE DOOR CLOSED
2—6"
B
B
2⅜"
1½"
3"
4"
A
VERT. SECTION AA
FIG 648
FIG 647
T+G + VEE SHEETING
CASING 3" × ⅞"
WEIGHT
MOULDED GUIDE
1½" FRAMING
GUIDE
FIG 649
PLAN SECTION BB.
FIG 650
PLAN SECTION C.C.

the egg-cup. These stands are also clearly shown in section *AA*, Fig. 645.

Plate racks should be constructed in a manner to suit the heavy weights placed upon them; for instance, the one shown will hold 240 plates, the weight of which demands that the best construction should be adopted. Fig. 646 shows the jointing. The top shelf is lap dovetailed to the gables and the two other shelves are housed-dovetailed to same. These pieces should be a full inch in thickness. The vertical divisions and side wings are housed to the shelves. The wings are also glued and screwed to the vertical divisions. The back is of five-ply and is screwed to the rebates in the gables and top.

Where the rack is of considerable length it should be supported by intermediate brackets of a design similar to the lower portion of the gables. Brass lugs are used to fix the rack to the bulkhead, the rack being very often placed over a dresser to be handy to the sink.

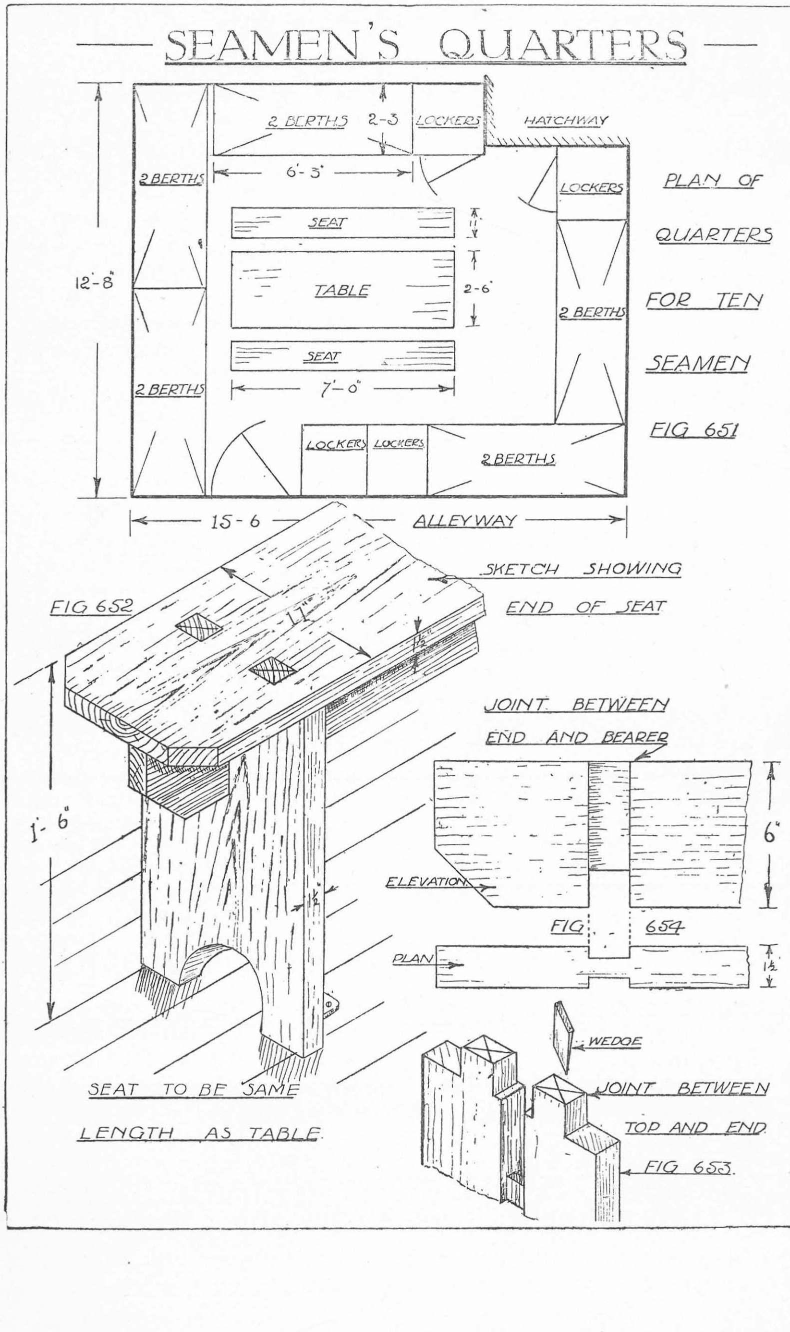
Various woods are used in their construction, but usually the same as for the other pantry fittings is adopted, and may be teak, mahogany, or canary wood.

Sliding Service Door.—Pantries are usually placed near to the public rooms which they are called upon to serve. In large passenger vessels, one is placed in close proximity to the dining saloon, one near to the smoke-room, and one to the officers' mess, etc. They are also in many cases connected to the galley, or kitchen, by a lift.

The stewards in the pantry, however, usually give out the supplies to serving-stewards through a *service window*, or *service door*, which is cut through the bulkhead into the working passage or direct into the saloon. In cases where this opening is required to transmit light into the pantry, or from the pantry to the passage, an *obscure glass panel* is fitted; but where this is not necessary a *wood* panel is used. This type of service window or door is also seen in bars to smoke-rooms, buffets, etc.

The *opening* is left in the bulkhead framing, and a *casing* is screwed to the pantry side of same to receive the sliding door. The casing is made complete in itself in the shop. It is formed of *pulley stiles* and *outer linings*, which form a pocket for the weights, and to which are screwed the *top* and *bottom linings*. The door is then made to slide easily in the casing, and is hung over pulley sheaves with copper chain and weights. The latter are covered with *felt* to prevent them from rattling in the pockets.

Two elevations are shown, half inside the saloon and half in the pantry; see Fig. 647. The opening in the framing is finished on the saloon side by a narrow moulding, and at the sill by a board and heavy supporting mould. The inside of the pantry is finished by sheeting, which encloses the whole casing and pockets.


SEAMEN'S QUARTERS
2 BERTHS
2-3
LOCKERS
HATCHWAY
6'-3"
2 BERTHS
LOCKERS
PLAN OF
QUARTERS
FOR TEN
SEAMEN
FIG 651
SEAT
11"
TABLE
2-6"
12'-8"
2 BERTHS
SEAT
7'-0"
2 BERTHS
LOCKERS
LOCKERS
2 BERTHS
15-6
ALLEYWAY
SKETCH SHOWING
END OF SEAT
FIG 652
11"
1½"
JOINT BETWEEN
END AND BEARER
1'-6"
6"
ELEVATION
1½"
FIG 654
PLAN
1½
WEDGE
JOINT BETWEEN
TOP AND END
FIG 653
SEAT TO BE SAME
LENGTH AS TABLE

The vertical section, Fig. 648, shows the opening on the pantry side higher than on the saloon side, to allow the *finger lifts* to be clear on the inside when the door is fully open. The top rail of the door is arranged to suit this by rebating and grooving, thus showing a parallel margin around the opening. The door slides between planted mouldings fixed round the opening, and guides are fixed to form a groove for the door when raised. *Rubber stops*, as shown in the vertical section, are nailed to the top. *Grounds* to which the sheeting is nailed are also shown. Plan section *BB*, Fig. 649, shows the details of the door when closed. It will be noticed that the door is of the flush panel type with a flat bead to break the joint. Plan section *CC*, Fig. 650, shows the details above when the door is open. The sheeting is carried right across and is finished at the angle by an ovolo mould.

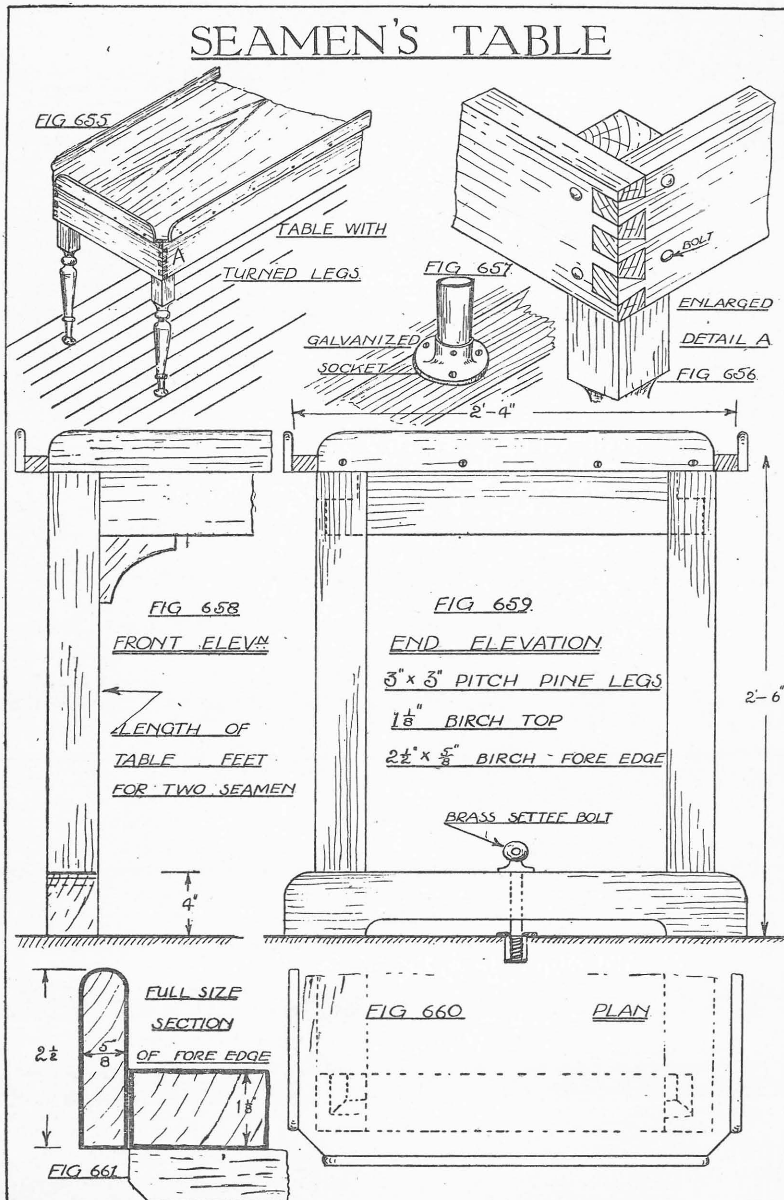
SEAMEN'S QUARTERS

Plan.—Fig. 651 shows the plan of quarters for seamen. They are often in the forecastle and are sometimes in the peak, but in merchant vessels it is not uncommon to see them amidships. The plan here given shows a general arrangement of a room to accommodate ten seamen, the name being marked on each fitting. The deck area and cubic contents of the room are governed by a BOARD OF TRADE regulation, and the number of men carried is governed by the number of berths provided. The regulation reads as follows :

> Section 210 of the Merchant Shipping Act 1894 provides that there must be for each man a space of not less than 72 cub. ft. and 12 sup. ft. Section 64 of the Merchant Shipping Act 1906, which came into operation on 1st June 1907, increases this amount in the case of new ships to 120 cub. ft. and 15 sup. ft. The number of men which the place is constructed to accommodate must be permanently cut in a beam inside the place with the words " Certified to accommodate —— seamen."

Fuller particulars of same can be seen in the Board's " Instructions as to the Survey of Masters' and Crew's Spaces."

Seat.—A simple seat which is commonly fixed in these quarters is shown in Figs. 652 to 654. Its length is usually the same as the dining table and the height is 1 ft. 6 in. It is made in spruce or pitchpine. Fig. 652 shows a sketch of one end of the seat. The legs are cut at the bottom to form two feet and are fixed to the deck by angle-iron lugs ; they are framed to the top by two tenons and are diagonal wedged as shown. A sketch of the top of a leg is shown in Fig. 653. The bearer underneath the seat is jointed to the legs by a bridle joint, which considerably strengthens them and keeps them in a vertical position. It will be


SEAMEN'S TABLE
FIG 655
TABLE WITH
TURNED LEGS
A
FIG 657
GALVANIZED
SOCKET
BOLT
ENLARGED
DETAIL A
FIG 656
2'-4"
FIG 658
FRONT ELEVN
LENGTH OF
TABLE FEET
FOR TWO SEAMEN
4"
FIG 659
END ELEVATION
3" x 3" PITCH PINE LEGS
1 1/8" BIRCH TOP
2 1/2" x 5/8" BIRCH FORE EDGE
BRASS SETTEE BOLT
2'-6"
FULL SIZE
SECTION
OF FORE EDGE
2 1/2
5/8
1 1/8
FIG 661
FIG 660
PLAN

noticed in Fig. 654 that the bridle is not carried to the full depth of the bearer. The bearer also prevents the seat from sagging in the centre of its length. This type of jointing forms a good strong seat. The materials are all $1\frac{1}{4}$ in. thick and the chief sizes are marked on the drawings.

Seamen's Tables.—In designing a table for seamen's quarters, the length should be such as to allow at least 1 ft. 9 in. of *length for each man* and the width should be 2 ft. 6 in. if both sides of the table have seating accommodation. The height of the table is 2 ft. 6 in. to the top of the leaf.

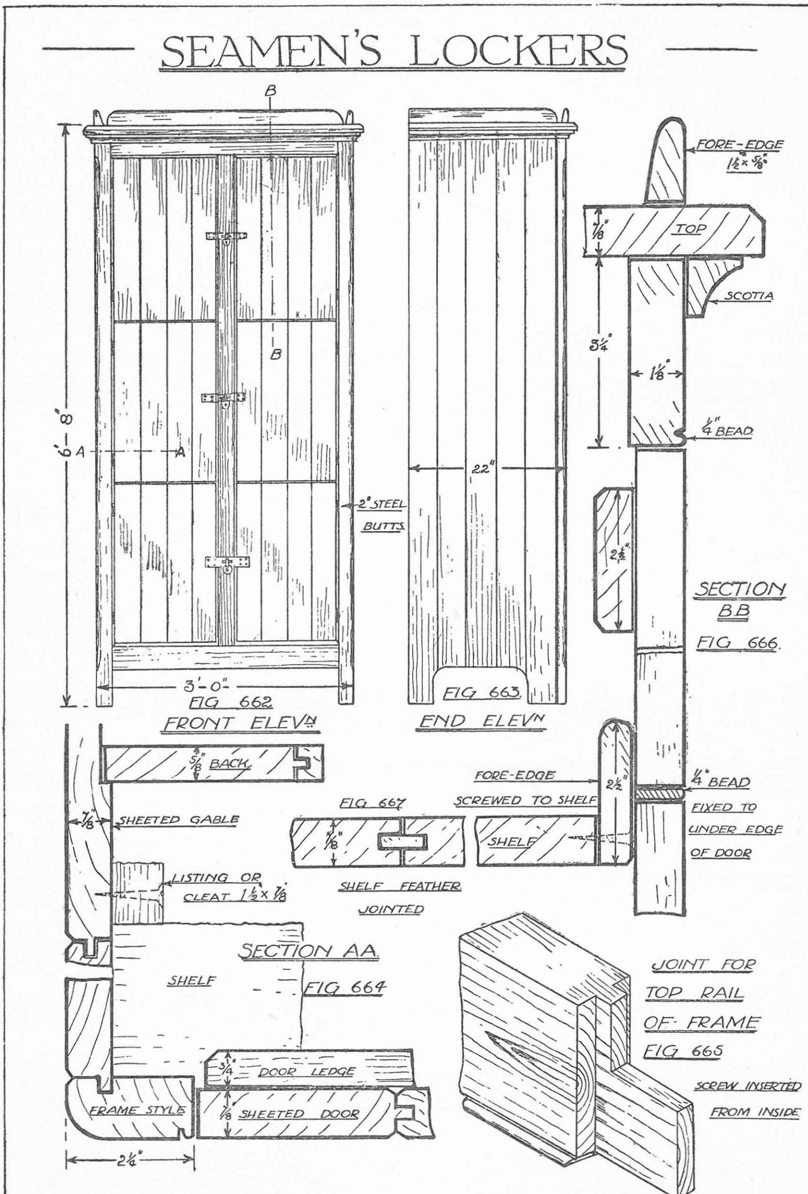
Two different types of tables are here shown. The table shown in Fig. 655 has turned legs and rails dovetailed together at the angles. The legs are checked to receive the rails, which are bolted through same, as shown in the enlarged detail, Fig. 656. The legs are fixed to the deck by galvanised sockets, shown in Fig. 657. The top, if in one piece, should be made of birch, and is fixed to the rails by buttoning from underneath. It is surrounded by fore-edges, which are left open at the angles to allow of the table being more easily kept clean. If spruce is used for the top, it should be jointed up in narrow boards, and tongued, grooved, and glued together.

The other type of table met with has the *ends framed together*, as seen in elevations, Figs. 658 and 659, and plan, Fig. 660. The top rails are made of pitchpine, 3 in. square, and are dovetailed into legs of the same size and material. A *bracket* is screwed between the side rails and the legs to assist in keeping the table square, as seen in the front elevation. The feet are jointed to the legs by a mortise and tenon joint, and they are scooped out underneath to obtain an easy method of fitting to the decks. They are fastened to the deck by a *brass settee bolt and nut* sunk into the deck.

The plan of the table shows by dotted lines the position and jointing of the legs and rails, also the shaping of the top at the angles. The fore-edges are planted on the edges of the table and are screwed in position : a full-size section of same is shown in Fig. 661. The top, if very long, should have intermediate bearers, which should be placed about 2 ft. apart and slot-screwed to the top. The holes in the fore-edges, which are planted on the end-grain, should also be slot-screwed, to allow of the free expansion or contraction of the top.

Seamen's Lockers.—Seamen are usually provided with one or two lockers, which are made in sets, as shown in elevation, Fig. 662. The carcase shown contains six separate lockers, and each pair is provided with a padlock. They are usually made of tongued-and-grooved boards glued together.

The *gables* are prepared, and *listings*, or cleats, are screwed on


SEAMEN'S LOCKERS
B
B
6'-8"
A
A
2" STEEL BUTTS
3'-0"
FIG 662
FRONT ELEVN
22"
FIG 663
END ELEVN
FORE-EDGE 1½ × 5/8"
7/8"
TOP
SCOTIA
3¼"
1⅛"
¼" BEAD
2½"
SECTION BB
FIG 666.
FORE-EDGE SCREWED TO SHELF
2½"
¼" BEAD FIXED TO UNDER EDGE OF DOOR
5/8" BACK
7/8"
SHEETED GABLE
FIG 667
7/8"
SHELF
SHELF FEATHER JOINTED
LISTING OR CLEAT 1½ × 7/8
SECTION AA
SHELF
FIG 664
3/4" DOOR LEDGE
FRAME STYLE
7/8 SHEETED DOOR
2¼"
JOINT FOR TOP RAIL OF FRAME
FIG 665
SCREW INSERTED FROM INSIDE

the inside to which the shelves are fixed. The front frame is mortised and tenoned together, and screws are inserted into the tenons from the inside. The stiles of the frame are grooved to receive the gables, as shown in section *AA*, Fig. 664, and the corner is rounded off. A bead is worked on the inside of the stiles and rails, the jointing of the rails being as shown in Fig. 665. A fore-edge is fixed to the front of each shelf, as seen in section, Fig. 666.

The doors are made in *one length* and are cut into three equal parts. Two ledges are used for each door and are screwed from the inside. The doors are fitted while in the full length, and when cut a bead is nailed to the lower edge of the upper and centre doors to break the joint and to show a continuation of the bead round each door. The shelves are arranged in such a position that the doors can be of equal size and meet in the centre of the fore-edges.

The top is jointed together and is nailed down to the gables and front frame. The upper edge is chamfered, as shown in vertical section, and a scotia mould is mitred around the under side to form a cornice. Fore-edges are fixed around the top to support sundry articles. The back, which is nailed to the top shelf and to the bottom, is also of tongued-and-grooved sheeting, and is fitted into a rebate in each gable.

Pitchpine or spruce is the wood usually employed for these lockers.

Oilskin lockers are also very often fitted near to the seamen's quarters, and are made similar to the lockers shown, except that they contain no shelves and the doors extend the full length of the locker.

CHAPTER XIV

COLD STORAGE AND INSULATION

INSULATION of Holds.—Special provision has to be made for carrying perishable foodstuffs on board ship. In passenger liners this is necessary for the food consumed on the voyage; while ships for carrying food cargoes have the holds insulated and refrigerating machinery installed, so that in almost every ocean-going vessel cold storage of some kind is required.

These holds and cold stores have to be insulated to prevent the cold air in them being affected by the warmer atmosphere outside, or *vice versa*. *Insulation* might be described as the covering of a hold, or chamber, all round with some non-conducting material, so that nowhere may the temperature of the hold be affected by the outside temperature. While it is almost impossible to have perfect insulation, much can be done towards attaining ideal conditions.

Imperfect insulation may be caused by leakages of the insulating material, badly fitting doorways and hatches, and air spaces caused by a shifting of insulations. Still air is a good insulator, but a current of air is not good, especially if coming in contact with materials which are good conductors.

Insulating Materials.—The chief materials employed for insulation are: *Cork*, both *granulated* and in *block form;* the latter has the advantage of not shifting when in position and does not settle, but the granulated is more suitable for getting into the awkward corners in a ship. Granulated cork is largely used on account of its lightness, and the fact that, should it leak through, it does no harm to most cargoes. *Silicate of cotton*, or *slag wool*, is used chiefly in positions requiring *fireproof* qualities, such as between boiler and passenger accommodation. It is not so suitable where it may become damp, as it retains the moisture and tends to set up dry rot in the woodwork. Silicate of cotton is packed to a density of 12 lbs. per cubic foot. Other materials are *charcoal*, *cow-hair*, *sawdust*, *felt*, and *waterproof paper*.

The thickness of the insulation varies, according to circumstances, and the *continuity* of same requires to be carefully watched, otherwise "local heating" may be set up.

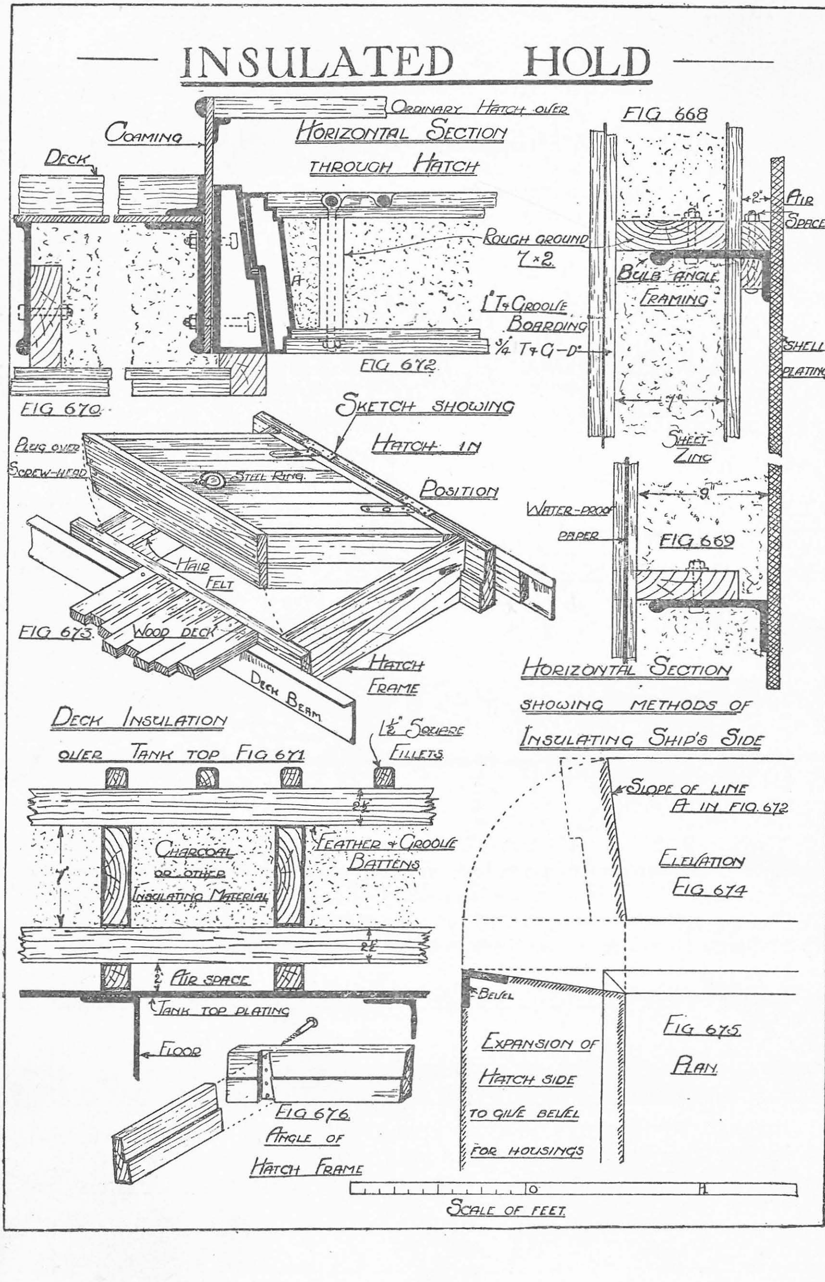
Double thicknesses of tongued-and-grooved sheeting are required to keep the insulating material in position. One or two thicknesses of waterproof paper is usually interposed between the two thicknesses of sheeting; this is, however, often omitted as it prevents ventilation reaching the inner boards.

Ship's Side.—Figs. 668 and 669 show sections through an insulated ship's side. The steelwork is thoroughly cleaned and painted, and where a cavity, or air space, is placed next the shell, as in Fig. 668, 2 in. square rough grounds are bolted to the angle irons; a thickness of boarding is then nailed to the grounds. The rough 7 in. by 2 in. grounds are then bolted to the steel framing, and the outer layer of $\frac{3}{4}$-in. boarding is nailed in position. Beginning at the bottom, about five boards are nailed on, and the insulating material is packed in; then another five boards are nailed on and filled in; and so on to the top. The waterproof paper is then tacked in position and the outer layer of boards fixed. *Fillets* are nailed at intervals of about 6 in. to allow an air space all round the cargo.

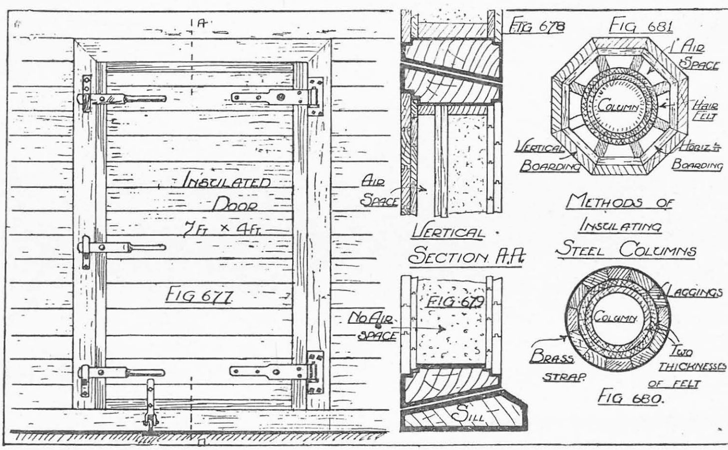
Under Side of Deck.—The under side of a deck is insulated, as shown in Fig. 670, and provision must be made for supporting the brine pipes, which are usually hung from the deck on galvanised steel hangers; the cold air tends to fall, hence the reason for hanging the pipes to the top of the hold.

Hold Floor.—The hold floor is insulated as shown in Fig. 671. In some cases, the insulating material is placed directly on the steel deck or tank top, as the case may be, and 7 in. by 2 in. grounds are fixed athwartship; 5 in. by 2 in. feather-and-groove battens are then nailed on the top of these. The floor follows the camber of the deck, and any moisture is allowed to drain to the ship's side through *scuppers* into the *bilges*. The floor is often covered with grating, or for frozen cargo $1\frac{1}{2}$ in. square pieces are nailed athwartship.

Hatchway.—Fig. 672 shows a section through a hatchway such as is fitted into a deck and used for loading the cargo into the hold. It is made air-tight on the "wedge principle." The construction is just like a hopper or splayed box. The corners are held together by housing the sides and ends. Grounds are placed at intervals, and the intervening space is filled up with insulating material, both sides being covered with a double thickness of boarding. The frame, which is bolted to the deck beams, is splayed and rebated to receive the hatch. Stout hinges are used, and a *ring bolt* is sunk flush into the surface and held by a bolt through one of the grounds. It will be noticed that the splayed edge of the hatch is also *rebated*, which makes it much easier to open than if the splayed edge continued throughout the full depth; see Fig. 673. This rebate is made air-tight by nailing two thicknesses of *felt*, one to the frame and one to the hatch, to form the joint. Figs. 674 and 675 show a method of obtaining the bevels for the ends and housing of the timbers. The same bevel will apply to both frame and hatch.


INSULATED HOLD
Ordinary Hatch over
Horizontal Section through Hatch
Coaming
Deck
Rough ground 7×2
1" T & Groove Boarding
3/4 T & G - D°
Fig 672
Fig 670
Fig 668
Air Space
Bulb Angle Framing
Shell Plating
Sheet Zinc
Sketch showing Hatch in Position
Plug over Screw-head
Steel Ring
Water-proof paper
9"
Fig 669
Hair Felt
Wood Deck
Fig 673
Hatch Frame
Deck Beam
Horizontal Section showing methods of Insulating Ship's Side
Deck Insulation over Tank top Fig 671
1½" Square Fillets
Slope of line A in Fig. 672
Feather & Groove Battens
Charcoal or other Insulating Material
Elevation Fig 674
Air space
Tank top plating
Floor
Bevel
Expansion of Hatch side to give bevel for housings
Fig 675 Plan
Fig 676 Angle of Hatch Frame
Scale of feet

Insulated Door.—Figs. 677 to 679 show the elevation and sections of a *vertical* door such as is fitted into a cold store. A *wheel* and *track* is adopted to support the door when open, as it may become distorted by sagging, due to its weight. Special arrangement has to be made to tighten the door into its place so as to make it air-tight. One method is by levers, as shown in Fig. 677, where the sockets are wedge-shaped and tend to force the door into its place. Another way is by angle straps across the corners and screws; the angle straps are pivoted and drop into sockets. To prevent accidents, it is necessary to be able to open the door from the inside, and the direction to turn the levers should be indicated inside the door.



Insulating Stanchions.—Two methods of insulating steel stanchions are shown in the horizontal sections, Figs. 680 and 681. In Fig. 681 the stanchion is shown with two thicknesses of felt wrapped round it. Vertical angular pieces are shaped to form the corners of an octagon, and to these are nailed first horizontal and then vertical boarding. Fig. 680 shows another method with no air space; the outer layers of boarding are held by galvanised iron hoops.

The insulation for *fruit-carrying holds* is effected by a *double belt* of insulation, and in between is formed a warm air trunk. The air is driven around this trunk and admitted to the hold through small ports at the sides. The hold is partitioned off by portable open sparring to support the cases or boxes of fruit.

When large holds are being insulated, a portable electric circular saw is used for cutting up the timber.

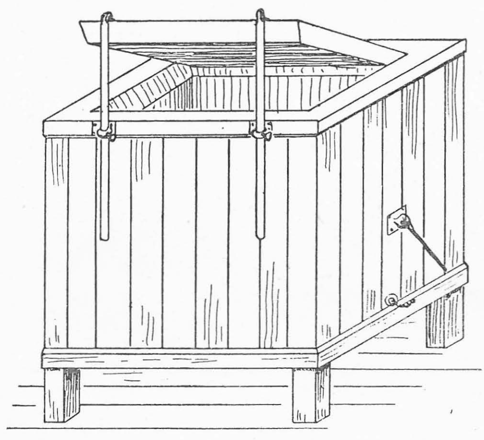
ICE CHEST

Ice chests are used for storing fresh meat or other perishable goods which have been taken from the cold storage. They are usually placed near the galley or kitchen, but should not be too near any source of heat.

The one shown in Fig. 682 is made up of four stout legs to which are mortised cross rails at the top and bottom. The top rails are bevelled to receive the door, which is also bevelled to make an air-tight joint. The sides and bottom are insulated by filling

ICE CHEST

FIG 682



LINED WITH ZINC

AND FITTED WITH TRAYS

the outer and inner thickness of boarding with granulated cork; 3 in. of insulating material is sufficient. The door is made up of a bevelled frame, housed and screwed at the corners, and rebated on both sides to receive the sheeting; it is also insulated.

The **ironwork fittings** include two strong wrought-iron hinges and two round iron bars to support the door when open. These bars work in two swivel rings, which are fitted with thumb-screws to hold the bars and lid in any desired position. The

inside is lined with zinc to prevent the moisture finding its way into the insulation. Lead is sometimes used for the same purpose; it is often only carried up about 6 in. from the bottom of the chest, having an air-tight bung. A pipe is also fitted to carry away any moisture.

The tongued-and-grooved boarding inside the chest is of pitchpine, and the remainder of the woodwork is in teak. The chest is lashed to the deck by cord and rings. The sizes of these chests vary, but the one shown is 3 ft. square inside.

Weather-deck Insulation.—Portions of deck-houses on a weather deck are often insulated and fitted up as cold stores, in which case it is necessary to keep out any drainage water. This is done by beating up sheet lead to fit in the angle between the deck-house and the deck, and then nailing it in position. Lead is also used to make the deck above perfectly watertight.

Gas-tight Bulkheads.—These bulkheads are fitted where it is desirable to prevent obnoxious gases from cargo or water-closets finding their way into living or sleeping compartments. Steel casings are sometimes built and caulked for this purpose; but where wood is employed, they are formed by fixing in position one layer of tongued-and-grooved boards, then over that a layer of canvas or asbestos, and finishing with another thickness of tongued-and-grooved boards.

CHAPTER XV

TIMBER

TREES may be divided roughly into two classes, *endogens* and *exogens*. The latter is the tree from which most of our timber is obtained, and a typical section is shown in Fig. 683. The names of the various parts are indicated on the sketch. The *pith* is in the centre and is surrounded by the medullary sheath and concentric layers called *annual rings*. The *medullary rays* radiate from the centre to the outer portion of the tree. The names of the various parts and a short description of each are here given.

The Heart, or Medulla, is the first growth of the stem and

SECTION OF OAK TREE

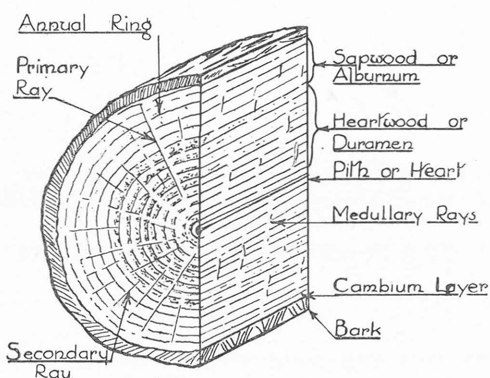


Fig 683

is entirely of cellular tissue. It carries the sap when the plant is young; but in later years it dries up, and is seen in mature timber as a loose red substance. It is a source of weakness in timber and is often cut out when converting; it is the first portion of the tree to decay due to extreme age. The heart of all the branches commences at the heart of the main stem.

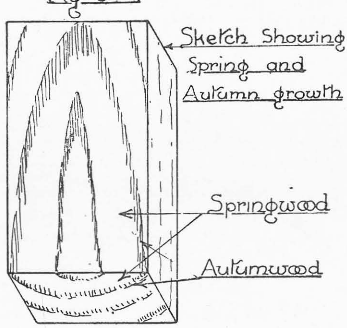
Medullary Sheath.—This is the first-formed ring around the heart. It protects the heart in the very young tree, but after the inner rings of wood are formed it serves no useful purpose, and in most woods cannot be distinguished from the other rings.

Heartwood consists of the annual rings near the centre of the tree. In the growing tree, it forms a rigid column to support and strengthen the stem. When converted, it gives the best and most durable timber, being much superior to sapwood.

Sapwood is the porous outer layers of the tree between the heartwood and the bark. On account of its porous nature, it allows an easy passage for the sap on its way from the root to the branches. This part of the stem is not durable and should not be used for any important work. Its colour varies but is generally lighter than the heartwood.

Annual, or Yearly, Rings is a general name applied to all the rings showing on the cross-section of a tree. In rapidly growing

Fig 684



trees, they are wider apart than in the slow growing ones; they are also wider in soft woods.

The annual ring is made up of two parts, the *spring wood* and the *autumn wood.* In the springtime the sap *ascends* to the branches, a part of the sap being deposited in the cambium layer directly under the bark; this latter deposit forms the spring wood of the annual ring. In the autumn, the sap, after undergoing chemical changes, *descends* and adds another and thicker coating, called the autumn wood. In most trees there is a distinct difference in colour between the spring and autumn layers, and this difference in colour clearly shows the year's growth, or annual ring; it also shows up to great advantage in the cut board, as will be seen in Fig. 684. To obtain the best figure due to this alternation of colours, the boards should be cut, as far as possible, tangential to the annual rings.

The Cambium Layer is directly underneath the bark—where the layers of sap are formed into wood.

The Medullary Rays, or the " silver grain," are vertical sheets of cellular tissue branching from the medulla to the outer rings of the tree. While they exist in most trees, they are only visible in oak, beech, and sycamore. They act as ducts along which the sap travels to nourish the inner part of the tree. There are long rays known as *primary* rays and short ones known as *secondary* rays.

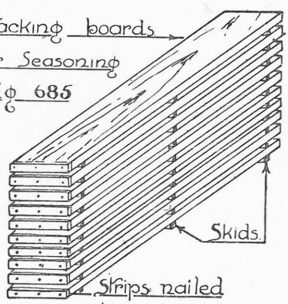
The Bark serves the purpose of protecting the cambium layer from injury.

SEASONING AND CONVERSION

" Green," or unseasoned, timber contain moisture and salts in solution which, if not removed, set up incipient decay. Also, if unseasoned timber is used, the moisture afterwards evaporates and allows the wood to contract considerably, which results in open joints and very defective construction. It is therefore important that timber be thoroughly seasoned before being used.

Natural Seasoning is considered the best, but it takes the longest time, and is the most costly, as large stocks have to be kept

Stacking boards for Seasoning
Fig 685



under cover. The wood should be stacked in sheds to protect it from rain and the direct rays of the sun, and a free current of air should be allowed to circulate all round each piece. Boards should have " skids "—that is, small pieces of wood—placed between them, as shown in Fig. 685, and should be turned over periodically and the skids moved along to prevent the wood being discoloured under the skid. Pieces of wood are often nailed to the ends of the boards to prevent them from splitting. The period taken for natural seasoning is roughly as follows: hardwoods two to three years, softwoods one to two years.

Hot-air Seasoning, or Desiccation.—The wood is placed in closed chambers through which pass currents of dry-heated air, thus absorbing the moisture in the pores. It is allowed to remain in the chamber from three to seven days, according to the size of scantling. The temperature is kept up to about 200° Fahr. This method is often only adopted as a *second seasoning ;* it has a tendency to make the wood brittle and bleaches some of the darker coloured woods.

Water Seasoning.—In this method the logs are placed with their butt ends towards the flow of the stream, and the sap is partly washed out ; this considerably reduces the period of natural seasoning. It has the disadvantage of discolouring the woods if the water is not perfectly clean.

Shrinkage Due to Seasoning.—Timber shrinks considerably during the process of seasoning. This shrinkage is more marked in the direction of the annual rings, as the medullary rays resist contraction in a radial direction. Hence the boards cut from the sapwood shrink most, and tend to take up the shape shown in Fig. 687. The effect of shrinkage on a quarter of a log is shown in Fig. 689, and the effect on a board cut from the log at *B* in Fig. 688.

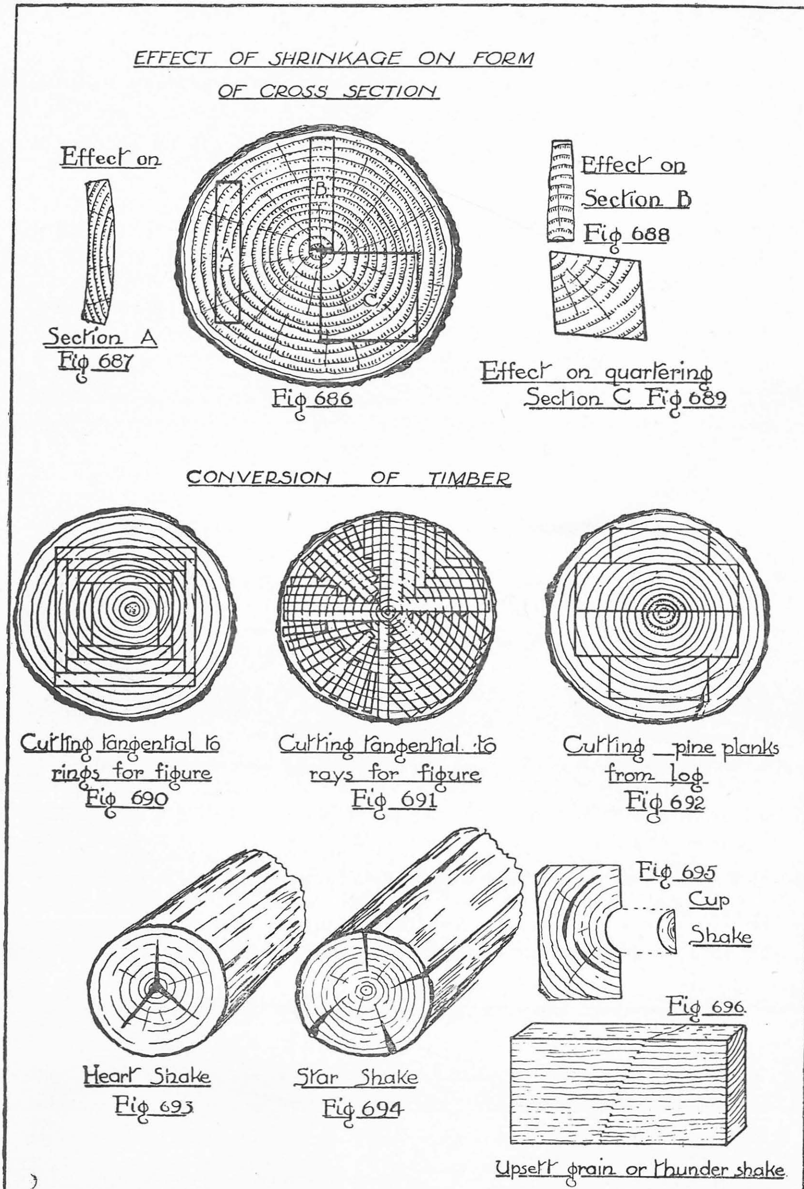
Conversion of Timber.—Timber is cut up in various ways according to the result desired : (*a*) to obtain boards with the best figure ; (*b*) to obtain the maximum amount of material ; or (*c*) to remove a decayed heart or other defects. Boards with figure known as "feather" should be cut tangentially to the annual rings, as is done with mahogany and pitchpine boards, and shown in cross-section, Fig. 690. Boards depending on the medullary rays for figure are cut as nearly parallel to the rays as possible ; this is a very wasteful method of cutting. The latter method, together with other less wasteful methods, are shown in Fig. 691. Oak for wainscoting and panels is cut with the face of the board tangential to the rays.

Pine planks having the smallest amount of sapwood are cut as shown in Fig. 692.

DEFECTS AND DISEASES

Among these may be included all kinds of shakes : *heart, star,* and *cup* shakes ; also diseases in the form of *dry rot, wet rot, dead, or druxy, knots,* and *over-maturity.* All these contribute to waste in conversion, and if present may result in the destruction of the finished article.

Heartshake is a shake commencing at the heart of the tree, where the *cleft* is widest. It is supposed to be due to the con-


EFFECT OF SHRINKAGE ON FORM
OF CROSS SECTION
Effect on
Section A
Fig 687
A
B
C
Fig 686
Effect on
Section B
Fig 688
Effect on quartering
Section C Fig 689
CONVERSION OF TIMBER
Cutting tangential to
rings for figure
Fig 690
Cutting tangential to
rays for figure
Fig 691
Cutting pine planks
from log
Fig 692
Heart Shake
Fig 693
Star Shake
Fig 694
Fig 695
Cup
Shake
Fig 696
Upsett grain or thunder shake

traction of the fibres in the early stages of decay caused by over-maturity ; see Fig. 693.

Starshake.—These are often caused by frost, due to the freezing of the sap, which bursts the fibre in the direction of the medullary rays ; see Fig. 694. They may also be caused by excessive heat. *Seasoning shakes* are similar, in that the widest part of the cleft is in the sapwood ; they are, however, not so large as starshakes and are more numerous.

Cupshakes, Fig. 695, are often invisible in the log and can only be seen when cut into planks ; often the loose piece drops out. They entail considerable waste in converting the timber, as they follow the course of the annual ring. They are supposed to be due to the twisting of the tree in high winds and to want of cohesion in the growth at different seasons.

An Upset, or Thunder Shake, is a crushing of the fibres across the grain, as seen in Fig. 696 ; they are a source of weakness, and disfigure any polished work considerably. They are caused by a violent concussion, such as is experienced in bad felling, or unequal loading in a ship.

Wet Rot is caused by a fissure in the bark, which allows water to enter ; the water is confined in a portion of the sapwood and becomes stagnant and sets up decay, the result of which is a patch of brown rotted wood in the cut timber.

Dry Rot is set up by insufficient ventilation. A kind of white *fungus* first appears on the surface of the wood, which ultimately crumbles away and becomes a mass of red powdery substance. The only cure is to cut away the affected parts.

Knots.—A *druxy knot* is one which is partly decayed, and usually drops out of a board. A *live knot* is one that is firmly embedded in the wood.

Preserving Timber.—The usual methods of preserving timber on board ship are by lead paint and polish. There is much need of a simple and effective method of making timber *fire-resisting*. Timber is often made more fire-resisting by filling up the pores with tungstate of soda or a compound of ammonia ; there are also several patent methods of rendering timber non-inflammable.

VARIETIES OF TIMBER

Mahogany.—Mahogany was introduced into Great Britain in the latter part of the sixteenth century. Later, it was used by the great designers of furniture, including Chippendale, Hepplewhite, and Inigo Jones ; and since that time it has held the premier position as a furniture wood. Its many good quali-

ties entitle it to the position it holds. It is a wood of rich colour and good figure; it shrinks and warps very little when seasoned; can be planed to a good surface, and takes polish well. It is also strong and fairly elastic, although some varieties become brittle with age. In shipbuilding, it is used largely for bulkhead framing and for all kinds of furniture, including state-room and public room furnishings. It is usually polished, but is also used for painted work where good construction is required.

Mahogany may be divided into four varieties: Cuban, Honduras, Mexican, and African.

Cuban, or *Spanish* as it is often called, is grown in Hayti, Cuba, Nassau, and Trinidad. The quality of the timber varies, but it may be distinguished from other varieties on account of it being darker, denser, and of better figure. It also has a white substance in its pores. The market sizes are smaller than those of the other varieties.

Honduras mahogany, sometimes called *Baywood*, is not so heavy as the Cuban and is lighter in colour. It is straight in grain and can be obtained in large sizes.

Mexican mahogany is similar in many respects to the preceding variety, but is not so good in quality.

African mahogany is shipped from Benin and Lagos on the Gold Coast. The quality is much inferior to the American mahoganies. Its colour is of a "pinky" tinge, and some of it is very spongy in texture.

Mahogany is imported in roughly squared logs up to 30 ft. in length and from 12 in. to 36 in. square. It weighs about 35 lb. per cubic foot.

Oak.—Oak is a good all-round timber in point of strength, durability, and figure. It stands the weather extremely well. There are several varieties, including English, American, Austrian, Dantzig, and Riga.

English Oak: This is one of the strongest and most durable varieties. It is of a light brown colour and rich in "silver grain," and is difficult to work on account of the grain being of a twisted character. The supplies are scattered and it is not easy to obtain large quantities at present.

American Oak is not nearly so good as the European varieties. It is less durable, coarser in the grain, and not so dark in colour. It is only used in inferior work and where strength is an important consideration.

Austrian Oak: This wood is probably the most useful of the oaks. It is straight in the grain, warps very little when seasoned, and when cut into boards shows good figure. It is light brown in colour and works easily.

Dantzig Oak takes its name from the port of shipment. It is grown in the Polish forests. It is of a dark brown colour,

and has a close, straight, and compact grain, with bright medullary rays ; it is very elastic and moderately durable.

Riga Oak is the product of the Russian forests and is similar in many respects to the Dantzig variety. It is noted for its particularly fine figure.

Most of the oak imported is shipped in half-round logs. Oak is used largely in ship-joinery work, for saloon panelling, furniture, parquetry for decks, stairs, etc. It contains a gallic acid which corrodes steel, the latter thus disfiguring the wood and turning it to a bluish colour. Ironwork should therefore be galvanised if coming in contact with oak. Its weight is 48 lb. per cubic foot when seasoned.

Teak.—Teak is largely used in shipbuilding on account of its weather-resisting properties and durability under different climatic conditions. It contains oil which, contrary to the gallic acid in oak, preserves ironwork attached to it. This oil also resists the attacks of insects. It is grown in Central and Southern India, Burma, and Ceylon, and is shipped in logs. It is of dark brown colour, straight in grain, free from knots, and gives off an unpleasant odour. There is a gritty substance in its pores which renders it difficult to work, as the tools used on it soon become blunt. It is used for decks, accommodation ladders, deck-houses, and all kinds of exposed woodwork. Its weight is 50 lb. per cubic foot when seasoned.

Walnut is imported from America and Italy. The latter variety is superior in figure, though more difficult to work than the American. The wood is strong and elastic and has a good figure. The medullary rays are invisible. It is used for saloon panelling, and presents a fine contrast if used with *mother-of-pearl* inlay. Its weight is 44 lb. per cubic foot when seasoned.

Elm is a very open-grained wood of a reddish-brown colour. It is fibrous, dense, and tough, and bears the driving of nails without splitting. It is very durable under water, but if subject to alternate wet and dry conditions is not so durable. It is "twisty" in the grain, and has a hard-wearing surface. Much of it is home grown, and some is imported from America. It is used for fender pieces for jetties, battens for covering decks, pilot ladders, and guard rails. Weight 38 lb. per cubic foot when seasoned.

Pitchpine grows over a large tract in the United States. It is very resinous, straight-grained, and fairly free from knots, with distinct annual rings. It shrinks and warps considerably, even after seasoning, and therefore is not suitable for high-class joinery. It is, however, much used on account of its rich figure, but should be framed in small scantlings. It is used for deck planking, deck-houses, deck ladders, etc., as it is fairly

durable when exposed to the weather. Weight 50 lb. per cubic foot when seasoned.

Spruce Fir, or White Deal, is imported in large quantities from Norway and Sweden, also from Canada. The quality of this timber varies a great deal; much of it is coarse-grained, knotty, and shrinks considerably. It contains an amount of resin, which is often found in ducts. The colour varies from a pale yellow to a brownish-white, and the sapwood has a bluish tint. The best qualities are used for dresser tops in pantries, furniture in seamen's quarters, insulation work, and grounds. Weight 32 lb. per cubic foot when seasoned.

Northern Pine, or Red Deal, is imported in deals and battens from the Baltic ports, being grown in the large forests in surrounding districts. It is very resinous, straight in the grain, knotty, and the annual rings are very clearly marked. It is soft, pliant, and easy to work. On account of the large quantity of resin in its pores it is very durable in exposed positions. Very little is used aboard ship, and then chiefly for grounds and deck planking. Weight 35 lb. per cubic foot.

Yellow Pine is sometimes called *Weymouth pine* or (in America) *white pine.* It grows in North America, Canada, Newfoundland, and Nova Scotia. It is of a pale-straw colour, with little difference between the spring-wood and autumn-wood. Showing in longitudinal section are short pores which show up as fine lines when filled with dirt. The grain is fine, straight, and even, having a lustrous surface when smooth, and is crystalline when magnified. It has a slightly resinous smell, and is fairly free from knots. It is very easy to work, but is not durable in exposed positions and is not very strong. On account of its lightness and even texture when seasoned, it is used extensively for painted bulkheads and the constructional and hidden parts of good-class furniture; it is also used for pattern-making. Weight 25 lb. per cubic foot.

CHAPTER XVI

MENSURATION AND FORMULÆ

MENSURATION may be divided into two parts, the first dealing with areas and perimeters, and the second with volumes and surface areas of solids. A knowledge of mensuration is of great use to the craftsman. Some of the essential rules should be memorised; and by a combination and application of the simple rules it will be found possible to compute areas and volumes of the more difficult figures.

The Square is a four-sided figure with all the sides of the same length, and all the angles right angles; see Fig. 697. The area is found by multiplying two sides together. If S is the length of one side, then Area $= S \times S = S^2$.

A Rectangle is any four-sided figure having opposite sides parallel and all the angles right angles. The area is found by multiplying the length by the breadth, thus:

$$A = l \times b.$$

The perimeter (that is, the distance measured around the outline) is equal to twice the length plus twice the breadth.

A Parallelogram is a four-sided figure with opposite sides parallel to one another; two of the angles are greater than right angles and two less than right angles. If the triangle shown dotted is subtracted from the left-hand side and added to the right-hand side, we get a rectangle of the same area, which is length multiplied by height:

$$A = l \times h.$$

The height should be measured perpendicularly to the base line.

EXAMPLE: Find the superficial area of a thwartship bulkhead: the horizontal distance between the ship's side and alleyway is 8 ft. 6 in. and the vertical height is 7 ft. 3 in. (*Note.*—On account of the deck sloping down towards the ship's side, the shape of the bulkhead will be a parallelogram, h being the distance between the ship's side and alleyway, and l the height.)

SOLUTION: $A = l \times h$

$= 8\frac{1}{2}$ ft. $\times 7\frac{1}{4}$ ft.

$= \frac{17}{2} \times \frac{29}{4} = 61\frac{5}{8}$ sq. ft. *Ans.*

Triangle.—The area is obtained by multiplying the base by the height and dividing by two. The height must be measured perpendicular to the base.

AREAS AND CIRCUMFERENCES OF PLANE FIGURES.

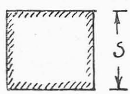
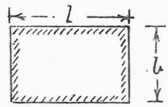
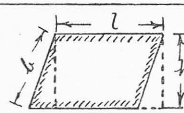
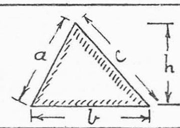
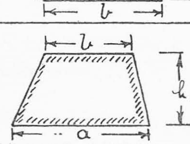
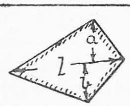
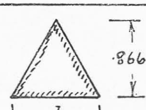
NAME	FIGURE	CIRCUMFERENCE OR PERIMETER	AREA
SQUARE		$4s.$	s^2
RECTANGLE		$2(l+b)$	$l \times b.$
PARALLELOGRAM.		$2(l+b)$	$l \times h$
TRIANGLE		$a+b+c$	$\frac{1}{2}(b \times h.)$
TRAPEZOID		SUM OF ALL FOUR SIDES.	$h\left(\frac{a+b}{2}\right).$
IRREGULAR QUADRILATERAL OR TRAPEZIUM.		SUM OF ALL FOUR SIDES	$l\left(\frac{a+b}{2}\right)$
EQUILATERAL TRIANGLE		$3b$	$\cdot 433\, b^2$

FIG 697

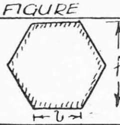
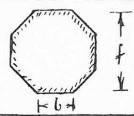
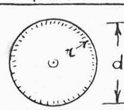
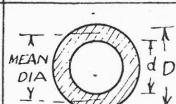
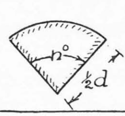
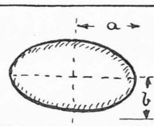
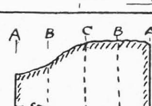
A Trapezoid is a four-sided figure with two of its sides parallel. The area is found by multiplying the average length (that is, *a* plus *b* divided by two) by the height *h*.

A Trapezium is an irregular four-sided figure. Its area can be found by dividing it into two triangles, and then taking the area of each one and adding together.

An Equilateral Triangle has three sides all the same length.

FIG. 698

AREAS AND CIRCUMFERENCES OF PLANE FIGURES.

NAME	FIGURE	PERIMETER	AREA.
HEXAGON		$6b$ or $3{\cdot}44f$	$2{\cdot}6b^2$ or ${\cdot}866f^2$
OCTAGON		$8b$ or $3{\cdot}32f$	$4{\cdot}83b^2$ or ${\cdot}829f^2$
CIRCLE		πd or $2\pi r$	$\frac{\pi}{4}d^2$ or $\frac{11}{14}d^2$ πr^2 or $\frac{22}{7}r^2$
HOLLOW CIRCLE			$\frac{\pi}{4}(D^2-d^2)$ or $\frac{\pi}{4}$ × MEAN DIA × THICKNESS.
SECTOR OF CIRCLE		LENGTH OF CURVE $\pi d\frac{n^\circ}{360}$	$\frac{\pi}{4}.d^2.\frac{n^\circ}{360}$
SEGMENT OF CIRCLE			SECTOR MINUS TRIANGLE APPROX $\frac{2}{3}$ h.c.
ELLIPSE		$\pi(a+b)$ APPROX OR $\pi[1{\cdot}5(a+b)-\sqrt{a.b}]$	$\pi.a.b$ or $\frac{11}{14}$ MAJOR AXIS × MINOR AXIS.
IRREGULAR FIGURE.			$\frac{S}{3}(A+4B+2C)$ A = END ORDINATES B = EVEN —DO— C = ODD —DO—

Its height is equal to 0·866 of the base. The area equals half the height multiplied by the base, thus :

$$A = \tfrac{1}{2} \times \cdot 866b \times b$$
$$= \cdot 433b^2.$$

Using this rule, the area of a hexagon can be easily found, as it is equal to six equilateral triangles ; see Fig. 698.

The Circle has a circumference which is a continuous line, and any point along the line is an equal distance from the centre. This distance is called the radius, and twice this distance the diameter. To find the area of a circle, square the diameter and multiply by $\frac{\pi}{4}$, taking π to equal $\frac{22}{7}$, which is accurate enough for most calculations.

EXAMPLE : To find the area of a circle having a diameter of 6 in.

SOLUTION : $A = \frac{\pi}{4} d^2$

$$= \frac{22}{7} \times \frac{1}{4} \times \frac{6}{1} \times \frac{6}{1}$$

$$= \frac{198}{7} = 28\tfrac{2}{7} \text{ sq. in.} \quad \textit{Ans.}$$

The circumference of a circle can be found by multiplying the diameter by π.

EXAMPLE : Find the circumference of a circle 8 in. diameter.

SOLUTION : $C = \pi \times d$

$$= \frac{22}{7} \times \frac{8}{1}$$

$$= \frac{176}{7} = 25\tfrac{1}{7} \text{ in.} \quad \textit{Ans.}$$

Area of an Irregular Figure by Simpson's Rule.—On account of the curved outlines of the different parts of a ship, this method is extensively used to find areas. The area, by this method, equals the common interval S divided by 3, and multiplied by the sum of the end ordinates + 4 times the even ordinates + twice the odd ordinates. *Note.*—For this rule the figure is divided up into an *even* number of parallel strips.

EXAMPLE : Find the deck area in a lounge ; the half-breadths at

TABLE OF VOLUMES AND SURFACE AREAS

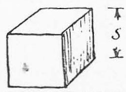
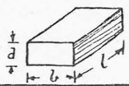
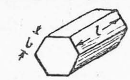
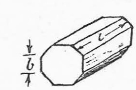
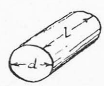
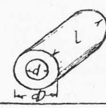
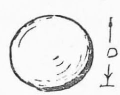
NAME	FIGURE	SURFACE AREA	VOLUME
CUBE		$6S^2$	S^3
RECTANGULAR PRISM		$2(lb + bd + ld)$	$l \times b \times d$
HEXAGONAL PRISM		SIDES $6lb$ ENDS $4{\cdot}2\ b^2$	$2{\cdot}6\,b^2 \times l$
OCTAGONAL PRISM		SIDES $8b.l$ ENDS $2 \times 4{\cdot}83\,b^2$	$4{\cdot}83\,b^2\,l$
CYLINDER		$\pi\, d.l$	$\frac{\pi}{4}\, d^2.l$
HOLLOW CYLINDER			$\frac{\pi}{4}\, l\,(D^2 - d^2)$
ELLIPTICAL PRISM		ENDS $2 \times \pi.a.b$ LATERAL SURFACE PERIMETER $\times\ l$	$\pi.a.b.l$
ANY PRISM		PERIMETER OF BASE X LENGTH	AREA OF BASE X LENGTH
SPHERE.		πD^2	$\frac{\pi}{6}.D^3$

FIG 699

5 ft. intervals are 14 ft., 15 ft. 6 in., 16 ft. 6 in., 17 ft., 17 ft. 6 in. The fore-and-aft distance is 20 ft.

SOLUTION: Area $= \frac{S}{3}\left(A + 4B + C\right)$

$$= \frac{5}{3}\left[(14 + 17\tfrac{1}{2}) + [4 \times (15\tfrac{1}{2} + 17)] + (2 \times 16\tfrac{1}{2})\right]$$

$$= \frac{5}{3}\left(31\tfrac{1}{2} + 130 + 33\right) = \frac{5}{3} \times \frac{389}{2} = 324\tfrac{1}{6} \text{ sq. ft.}$$

$$= 324\tfrac{1}{6} \times 2 = 648\tfrac{1}{3} \text{ sq. ft. } \textit{Ans.}$$

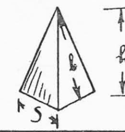
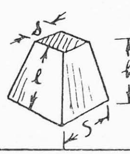
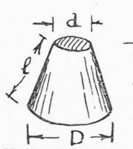
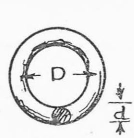
TABLE OF VOLUMES AND SURFACE AREAS			
NAME	FIGURE	SURFACE AREA	VOLUME
SQUARE PYRAMID		$2.S.l.$	$\frac{1}{3}.S^2.h$
CONE		$\frac{l.\pi.D}{2}$	$\frac{\pi}{12}D^2h$
FRUSTUM OF SQUARE PYRAMID		SLANT SURFACE $2l(S+s)$	$\frac{h}{3}(S^2+s^2+Ss)$
FRUSTUM OF CONE		SLANT SURFACE $\frac{\pi l}{2}(D+d)$	$\frac{\pi h}{12}(D^2+d^2+Dd)$
RING WITH CIRCULAR SECTION.		D = MEAN DIAM $\pi^2.D.d$	$\frac{\pi}{4}d^2 \times \pi D$

FIG 700

VOLUMES

A prism (see Fig. 699) is a solid having two ends parallel and of the same shape. In a right prism the sides are all rectangles. The volume of any prism can be found by multiplying the area of one end by the length. For purposes of calculation the cylinder can be regarded as a prism. Prisms are named after the shape of the end: for example, a rectangular prism has rectangular shaped ends; a hexagonal prism has a hexagon at each end.

Pyramids.—The volume of a pyramid (and cone) is one-third that of its enclosing prism.

A Frustum of a Pyramid is the remaining portion after cutting off a small pyramid from the top, the two ends being left parallel; see Fig. 700.

EXAMPLE: Find the weight of a piece of pitchpine; the base is a square of 6-in. side, the top is a square of 4-in. side, and the height is 6 ft. Take the weight as 46 lbs. per cub. ft.

SOLUTION: $V=\frac{h}{3}\left(S^2+s^2+Ss\right)$

$$=\frac{6}{3}\left[\left(\tfrac{1}{2}\times\tfrac{1}{2}\right)+\left(\tfrac{1}{3}\times\tfrac{1}{3}\right)+\left(\tfrac{1}{2}\times\tfrac{1}{3}\right)\right]$$

$$=2\left(\tfrac{1}{4}+\tfrac{1}{9}+\tfrac{1}{6}\right)$$

$$=\frac{2}{1}\times\frac{19}{36}=1\tfrac{1}{18}\text{ cub. ft.}$$

$$\text{Weight}=\frac{19}{18}\times\frac{46}{1}=48\tfrac{5}{9}\text{ lbs.}\quad \textit{Ans.}$$

CITY AND GUILDS OF LONDON INSTITUTE

55B.—Ship Joinery

Grade I

Friday, May 5th, 1922, 7 *to* 10 *p.m.*

INSTRUCTIONS

Drawing instruments may be used in this Examination ; but pen-and-ink sketches, neatly drawn, will be sufficient. Drawings to scale are not required.

Three hours allowed for this paper.

The maximum number of marks obtainable is affixed to each question.

Not more than *eight* questions to be attempted.

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1. What is parquetry ? Of what material is it usually formed, and how is it fitted and fastened ? (*32 marks.*)

2. How would you set out an ellipse 6 ft. by 4 ft. and a regular octagon of 8 ft. inside diameter ? What is the area of such an ellipse ? (*40.*)

3. Sketch a six-hole fire-bucket rack and fastenings. (*34.*)

4. Make a dimensioned sketch of a dovetailed tongue and groove joint connecting two timbers so as to form a T. (*38.*)

5. What woods would you suggest for the ceiling, walls, and floor of a first-class smoke room ? What floor covering would you adopt ? (*30.*)

6. What hand-planes should be found in the kit of a ship-joiner ? How is the blade fixed in a wooden plane and how is it sharpened ? (*37.*)

7. Describe a machine suitable for cutting mouldings on the edges of a door frame. (*36.*)

8. Sketch an accommodation ladder of which the steps remain horizontal whatever the slope of the ladder. (*35.*)

9. A 'tween-deck space 52 ft. in width has vertical sides, a camber of 3 in. on the lower and of 15 in. on the upper deck. It is desired to fit across its whole width a partition formed of portable spars of pitchpine, the spars being vertical and measuring 4 in. by $2\frac{1}{2}$ in. with 2-in. gaps. The decks are 8 ft. apart at each side top of beam to top of beam ; the lower deck has $\frac{1}{2}$-in. steel plating and 3-in. wood planking ; the upper deck has 9-in. channel beams and steel plating. Draw a section through the partition, which is alongside of a beam, and estimate its total weight. (*41.*)

10. What is plywood ? How is it made, and where used ? (*39.*)

11. Describe any three of the commonest defects in timber. (*30.*)

12. How should an oak log be converted to planks so as to retain the silver grain ? (*30.*)

City and Guilds of London Institute

55b.—Ship Joinery

Final Examination

Friday, May 5th, 1922, 7 *to* 10 *p.m.*

Instructions

Drawing instruments may be used in this Examination ; but pen-and-ink sketches, neatly drawn, will be sufficient. Drawings to scale are not required, except where specially asked for.

Three hours allowed for this paper.

The maximum number of marks obtainable is affixed to each question.

Not more than *eight* questions to be attempted.

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1. Draw a half transverse section of a lower 'tween-deck space suitable for the carriage of chilled meat. Show the ship's side, both decks with their beams and beam knees, all insulation and the meat rails, and give figured dimensions throughout. (*35 marks.*)

2. Define stress, strain, and modulus of elasticity. (*25.*)

3. A uniform rod, 50 feet in length and one-quarter inch square in cross section, is found to stretch six-tenths of an inch under a pull of 15 cwt. Estimate the stress, the strain, and the modulus of elasticity. (*35.*)

4. Draw a fully-dimensioned plan and section of a chart table, showing chart guard, chart drawers and chronometer box. (*35.*)

5. Two four-foot circles touch at the centre of a five-foot circle. Draw these to scale and show how to obtain the mitre lines for the six panels contained within the circles. (*40.*)

6. Describe the method used to season timber by natural means ; and also any process of preserving timber. (*25.*)

7. Make a sketch showing the principal dimensions of a dining-table and chairs to accommodate four first-class passengers. Show the fiddles and the methods of securing the furniture to the wood deck. (*40.*)

8. A beam, 24 feet in length, is supported, but not fixed, at each end. Loads of 3, 15, 8, 12 and 9 tons are placed upon it at four-foot intervals and in the above order. Draw the curves of shearing force and bending moment, marking the numerical values of the ordinates. If the same beam be cut at the centre and supported there by a truss five feet in depth, estimate the maximum bending moment in each portion and the forces in the strut and tie rods of the truss. (*45.*)

9. Make a drawing of a ladder forming the exit from a compartment accommodating 200 third-class passengers. Show the handrails, fixings, and method of construction. Mark on your drawing the principal dimensions to which the ladder must be constructed in order to meet the requirements of the Board of Trade. (*40.*)

10. Estimate the weights of the timber and metal required to form the ladder described in the previous question. (*30.*)

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PRINTED IN GREAT BRITAIN BY
THE EDINBURGH PRESS, 9 AND 11 YOUNG STREET, EDINBURGH.